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ELECTRICAL WORLD AND ENGINEER.

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LIGHTS IN NEW YORK.

Last week we noted the fact that the municipal arc lights at Holyoke, Mass., were cited as an example of cheapness against the arc lighting of New York by private contract. We have since looked up the data, and find that the comparison is absurd, as we said. New York has been paying $146 for full arcs, all night, on underground circuits, while Holyoke is charging itself $100. But, it appears, all the circuits in Holyoke are overhead, and the lights are only 6.6 amp., or "half arcs." Besides, Holyoke has water power as well as steam. It will be seen at once that New York City is getting a good service very cheaply, as compared with Holyoke, and not dearly. The general opinion is that Holyoke's plant has been well run, yet it can do no better than $100 a year for half arcs, with overhead wires. In New York, Boston, Chicago and other like cities the additional cost of underground service alone per arc is just about $40.

ONE THING CHEAPER.

All of us have been painfully aware in recent years of the rapid increase in prices and in the cost of living. "Everything has gone up," is the cry, and Alice Coburn, in the New York *Evening Post*, gives chapter and verse to prove it. This lady goes over item by item in her article, two columns long, comparing 1904 with 1894, and what she states is not to be gainsaid. "Furthermore, a comparison of the two periods reveals a much greater increase in the cost of necessities than in the price of luxuries," in which also we will not venture to contradict her, with one great exception. She mentions gas herself as being 25 cents per thousand cheaper on Manhattan Island, but has an unladylike sneer at the "apparent" quality, as much as to say that the difference between $1.25 and $1 has been made up by adulteration. That is not true, but we are not here to stand up for gas. We came to bury Cæsar, not to praise him. What we do want to vindicate on the score of greater cheapness in ten years is electricity. There is not a department of electrical service to the public that is not cheaper and better in 1904 than in 1894. Trolley rides for 5 cents are much longer, the universal transfer system has cut the fare to much below 5 cents, and the service is infinitely improved, on surface, overhead or underground. Telephony is better, quicker, much cheaper, and available to everybody. Electric light and power are both cheaper and better, all over the country as in New York, and while the cost of every constituent item entering into production has risen—fuel, wages, rent, taxes, etc.—the price of current has been persistently lowered. The companies don't get much thanks for this, done chiefly on their own volition. On the contrary, they are consistently or inconsistently damned just the same and about as usual, but the great fact remains in their favor.

AN ALTERNATING-CURRENT RECTIFYING EFFECT.

In our correspondence columns this week is a letter to the effect that a direct current flows between a copper trolley wire and its steel suspension cable when both are employed in parallel with alternating-current railway motors. This means that both the steel suspension cable and the copper trolley wire suspended therefrom, carry alternating currents in parallel. Under these circumstances it is not at all clear why a rectified current should flow through any of the suspension ears. If we assume that the steel wire is a conductor

differing only from the trolley wire in having a different resistance, and markedly greater inductance, then it is not apparent why there should be any interchange of current between the two, except where the trolley wire gives current to the car or cars. The current in the steel cable would be delayed in phase with respect to the current in the trolley wire, but this difference in phase of the two currents does not seem to involve any interchange of current. Moreover, if interchange of current took place, it would be an alternating current. Of course, the fact that one of the conductors is steel, while the other is copper, opens the door to a variety of secondary possibilities, due to the dissymmetry, such as the skin effect, thermo-electric forces, etc. It would be desirable for our correspondent to make some measurements of the alleged rectified current, because if the facts are as represented, the explanation should be of much interest. Until such measurements are forthcoming, however, we believe no method is known whereby a direct current can be obtained in any branch of an alternating-current conducting network.

The Silver Voltameter.

Bulletin No. 1 of the Bureau of Standards at Washington contains a study of the silver voltameter by Dr. K. E. Guthe. A paper on the same subject was communicated by Dr. Guthe to the International Electrical Congress, of St. Louis. The paper describes a variety of forms of the silver coulombmeter and shows that a given quantity of electricity passed through these different types of cell may give slightly different deposits of silver on the cathode. In one and the same voltameter, however, the deposit obtained for a given transfer of electricity appeared to be capable of repetition to about 1 part in 10,000, or one-hundredth of one per cent. Taking the Clark cell as having an e.m.f. of 1.434 volts at 15° C., the electrochemical equivalent of silver is shown to work out 1.1168 milligrams per coulomb. The legally accepted value is 1.118 milligrams per coulomb. If, however, the Clark cell were taken at 1.433 volts, the corrected value would more closely approximate to the legally adopted value. A table is given at the end of the paper collecting the values for the electrochemical equivalent of silver, as found by seven different observers between the years 1882 and 1904. The values range between 1.1167 and 1.1193 milligrams per coulomb, the arithmetical mean of which is 1.118, the adopted value.

The final result of the paper leads to the conclusion that the electrochemical equivalent of silver still remains in doubt to one part in one thousand, or one-tenth of one per cent. Consequently, silver voltameter measurements, while no doubt capable of great precision under given conditions of apparatus, are not of greater precision in the hands of different observers than observations standardized by reference to the Clark cell. On the other hand, the Clark cell, when used with a potentiometer, is far more swift and convenient as a standard of testing or of calibration than the silver coulombmeter. With the latter apparatus, pure chemicals have to be provided, beakers have to be scrupulously cleansed, solutions to be standardized and a standard current indicator to be calibrated by repeated measurements, each lasting many minutes and requiring much time for drying, weighing and computing. Such work requires manipulative skill and expert training. The potentiometer and Clark cell, on the other hand, can be readily applied over a wide range of current or voltage with a high degree of accuracy, and with far less demand for expert training.

Even if the electrochemical equivalent of silver should be determined to a higher degree of accuracy than is at present possible, it will only be practicable to employ the silver coulombmeter as a secondary standard of current measurement in a few important laboratories, such as that of the National Bureau of Standards. The bulk of the work of checking and standardizing measuring apparatus must be effected through the use of the standard cell. For this reason specifications for the manufacture of standard cells capable of giving a definite e.m.f. with considerable accuracy are of great technical importance.

St. Louis Meeting of the A. A. A. S.

The volume of *Proceedings* of the A. A. A. S. for last January's meeting has recently been published. It is a good-sized volume of 634 pages; but alas! it is more than half occupied by the names of the members. It is a most remarkably unscientific condition for the publication of the Association for the Advancement of Science, that half the publication should be padded with what is practically of no interest whatever, to the exclusion of matter which would greatly interest the members. What advantage can it be to any one member to have his bookshelf space annually occupied by a list of several thousand other members? It would seem to be sufficient that such a list should be on file at the secretary's office for delivery on demand to such members as desired to receive it. The section on Physics is stated to have read 28 papers, just half of which appear by their titles to have been of an electrical nature, and, therefore, of a nature likely to be of interest to our readers. Yet although one pound avoirdupois of paper and over 300 pages are wasted on the membership list, not one of these papers is printed. Again, in the section on Mathematics and Engineering, 25 papers are stated to have been read, at least one-third of which, judging by their titles, might be of interest to our readers, yet none of them is printed. Finally, the parts of the book that are of interest to intelligent readers are made repellant, and artificially hard to read by leaving the pages uncut.

The addresses published in the book are, however, well worth cutting the pages to read. For example, the address in Section A, by Prof. G. B. Halsted, contains a strong appeal for the recognition of non-Euclidian geometry. Euclid, in building up the system of geometry that forms the theoretical basis of all our working mathematics, so far as relates to lines and drawings, started with certain assumptions or postulates. One of these is to the effect that two intersecting straight lines cannot *both* be parallel to a third straight line. One of the propositions of Euclid involving the above-mentioned postulate is that any two sides of a triangle are together greater than the third. The Sophists used to declare that even Athenian donkeys knew this and would choose a straight path rather than two sides of a triangle leading to the same point. Another Euclidian proposition, likewise involving the same postulate, is that the sum of the interior angles of a triangle are equal to two right angles. According to the modern geometry advocated by Prof. Halsted, neither Euclid nor we have any right to assume the necessary truth of the postulate. If we deny the postulate, we obtain two non-Euclidian geometries, differing markedly from the Euclidian and from each other. In one of these, the sum of interior angles of a triangle is greater than two right angles, in the other it is less. In one of them two sides of a triangle may, together, be less than the third.

As a matter of pure mathematics, it is no doubt correct to call in question all postulates that cannot be demonstrated. If we take any triangle, such as that bounding a delta-shaped field, and measure the interior angles by a theodolite, their sum is, by all experience, certainly extremely close to the Euclidian two right angles. It has never been determined that the sum is definitely more or definitely less. The degree of coincidence with two right angles is certainly close enough to warrant the adoption of Euclidian geometry for

all terrestrial affairs. Nevertheless, we have no means of demonstrating that when the triangle becomes, say, a million times larger in linear dimensions that the sum of the angles remains exactly two right angles. In case it should be in any degree more, the hyper-Euclidian geometry would be indicated. If it should be in any degree less, the infra-Euclidian geometry would be indicated. As a matter of pure mathematics, there is interest in discovering the relations of non-Euclidian geometry in either case. For example, space would cease to be necessarily infinite. So far as concerns practical men and engineers, however, our duty remains to be content with the rules and theorems of Euclidian geometry, until such time as they can be proved to be in error by observation. Until that day comes, non-Euclidian geometry must be speculation to the practician, even although gospel to the pure geometrician.

TRANSCENDENTAL POWER TRANSMISSION.

Our readers will no doubt be much interested in Mr. Mershon's highly speculative paper on transmission of power in very large blocks to enormous distances, an abstract of which and of the accompanying discussion will be found elsewhere in this issue. We use the term speculative in no derogatory sense, but merely to suggest that the investigation is hardly of a character to become practical in the immediate future or before conditions with respect to power transmission are profoundly changed. To begin with, practically the whole of Mr. Mershon's study lies in a region far beyond the present confines of the art. It is not that power has not been even now sent over distances of several hundred miles for commercial use, but that the amounts and the voltages on which his figures are based are entirely outside present conditions. Niagara is the only power within even thinkable distance of a present market that is big enough to fit the case, and it is notorious that Niagara has thus far done substantially nothing at any considerable distance, finding better profit in short range distribution. The great falls of the Zambesi and the tremendous cataract recently discovered in South America are the only sources of hydraulic power of a magnitude suited to Mr. Mershon's calculations, and these are many hundreds of miles from even meagre markets. Still, a study of possible economic conditions in sending say half a million kilowatts five hundred miles is not without value of a prophetic sort and some of the conclusions are striking. A few weeks ago we published an article by Mr. Wallace on a 200-mile transmission, and it may not be uninteresting to compare the results reached by the two investigators. No exact comparison is feasible, since Mr. Wallace's data are within the range of present experimental knowledge, while Mr. Mershon really begins his work at voltages above those which can now be used, with lines longer than are now employed in transmission of power in large blocks.

Mr. Wallace assuming 25,000 kw transmitted, which is and probably always will be a large transmission from a single power in a single block, finds that a 200-mile transmission is barely feasible using 60,000 volts with a generating cost of $15 and a selling cost of $50 per year per kilowatt. Mr. Mershon, with about $23 per kilowatt year margin of profit figures out a 7 per cent. profit for such a transmission at about 84,000 volts. Considering the uncertain values of many of the data this is a reasonable agreement. Stated broadly, it is a fair conclusion that a 200-mile transmission of good size, granting low cost of power production and a more than usually good market, can be made to pay when worked near unity load factor and at a voltage not greatly in excess of that now available. Now we can go a step further. Mr. Mershon's special feature is the study of the variation of cost with the amount of power. For a given amount of power there is no great gain in raising the voltage above a certain point, but some of the costs being nearly independent of the amount of power, the economic outlook is improved by increased size of plant. Thus few would be disposed to dispute Mr. Mershon's figures in showing far better returns from the delivery of 50,000 kw than for 25,000. With the larger block of power the chance for a profitable enterprise would be excellent. We must not lose sight of the fact that 50,000 kw straightaway transmissions are and always will be scarce. The main objection to taking Mr. Mershon's figures too seriously is the size of the transmission units assumed. When a single source permits the delivery of 100,000 kw or even half that amount, it will be a rare exception if the whole transmission is along a single line, and it is the linear case which has here been investigated. The more normal instance is the delivery of the power in blocks of 10,000 to 25,000 kw in various directions from the plant.

Under such circumstances the line costs run far higher than those assumed by Mr. Mershon, both in first cost and maintenance. The only saving grace in the situation is the possibility of working such a system as a network from several plants, a condition which neither Mr. Mershon nor anyone else has properly investigated. The great need at present is the power of dealing with such voltages as are required for Mr. Mershon's larger work. That the present difficulties will be conquered goes without saying, but it is certainly hazardous to say that when we get insulators for 150,000 volts they will be materially more expensive or difficult to maintain that those now made for 60,000. The change in construction that will give us 150,000 volts as a working pressure we cannot now predict, but it certainly will have to be revolutionary, and is quite as likely as not to be relatively inexpensive. From the financial standpoint there is much to be said both pro and con Mr. Mershon's views. Long before the world gets to delivering power in huge blocks like those considered, one will be sure of seeing investments on a 2 or 3 per cent. basis, so that "paying" will take on a new signification. On the other hand, with the increasing costs of fuel the value attached to the available hydraulic powers will be enormously enhanced, and enormous sums will be spent in working up powers now quite out of consideration. The change of producing power at Mr. Mershon's low figure strikes one as being practically nil, while his selling price, at present high for large blocks, will perhaps some day sound ultra-conservative.

Taking Mershon and Wallace together it is not too much to say that they have made out a pretty good case for the practicability of commercial power transmission over distances of several hundred miles, provided the amount delivered is very large and the market is good. To this we must add the warning that we are as yet very far indeed from having methods of insulation adequate for such work. We need insulators having several times the factor of safety now allowed in high voltage work, and in particular reliable means of dealing with lightning. The bigger the amount of energy transmitted over a single line the more serious is a breakdown, and we know of no line even fifty miles long with the record of immunity from accident that would be a *sine qua non* of the electrical supply of New York City from Niagara. In conclusion, we may say that the really important feature of the Mershon paper is not concerning the limiting distance over which power may be transmitted, but rather that when power in large blocks is transmitted to any considerable distance, the economic size of the copper wires is quite large, even with three-phase pressures as high as 170 kilovolts, so that there is no fear of dissipating power wastefully by brush discharge. Aluminum wires of relatively larger diameters are not, therefore, needed. In other words, to carry large powers over considerable distance requires economic sizes of copper wire that will stand very high voltages before dissipating their energy by brush discharge.

What Electricity on the Central Means.

Vice-President W. J. Wilgus, in a recent most interesting article on the adoption of electricity by the New York Central Railroad, says, after giving some details with which our readers are already acquainted:

"The hauling of 800-ton trains laden with passengers, mail and express, at speeds exceeding 60 miles per hour, with regularity and safety, had not been attempted by electricity. The Grand Central Station, with its complex system of tracks and switches and handling from 500 to 700 trains in twenty-four hours, presented a problem of unusual difficulty. Moreover, the change of power naturally involves the embarrassment incidental to the successful maintenance of an existing enormous traffic in conjunction with radical changes in roadbed and structures. As a result of this thorough investigation of the entire subject, the company finally decided in 1902 to proceed with the change of motive power, and in the following year the State and municipal authorities gave their sanction.

"This decision carries with it the necessity for the improvement and enlargement of the Grand Central Station; the increasing of the size of the Grand Central yard, and the depression of the grades in such a manner as to permit the passage overhead of cross streets from Forty-fifth Street to Fifty-sixth Street, inclusive; a new underground suburban terminal beneath the station, with the possibility of a connection with the Rapid Transit Subway in Forty-second Street; the four-tracking of both the Hudson and Harlem divisions within the electrical zone; the elimination of grade, street and track crossings within the same zone; the straightening of alignment at various places, as for instance at the Marble Hill cut-off in the Borough of the Bronx, and important station improvements at many places.

"The handling of through trains by electricity presents many very interesting problems. The wire range of train weights and speeds now requires many types of steam locomotive, whereas the adoption of electricity makes possible the use of but one type and size of locomotive, capable of being governed and grouped so as to be suitable for both main line and switching service. From the several plans submitted in accordance with the general requirements laid down by the commission, a selection was made of the design offered by the General Electric Company, consisting of a double-ended 2,200-hp electric locomotive, equipped with a new type of gearless bipolar motors. The total weight of this machine is to be 85 tons, of which 67 tons will be borne on four pairs of drivers. Compared with existing steam practice, it will be interesting to note that the heaviest "Atlantic" type locomotive of this company weighs 150 tons, including the tender, of which but 47 tons are on the two pairs of drivers. It will, therefore, be seen that for every pound of effective drawbar pull the steam locomotive has a weight of 12.2 pounds, as compared with the electric locomotive's economical weight of but 5.2 pounds. This gives in a single electric unit over 25 per cent. greater weights available for traction than the largest steam locomotive now in use in this service, with 43 per cent. less dead weight, and with 29 per cent. less weight on each axle. Moreover, the electric locomotive will have an entire absence of counterbalancing of drivers and twist from reciprocal motion, both of which are so destructive to track and roadbed.

"The question of size and exact character of the suburban cars has not yet been settled. Unfortunately, a car designed for the comfort of passengers riding comparatively long distances will be too large to enter the subways, and therefore an interchange of equipment may be found to be impossible. In any event, convenient facilities for the interchange of passengers between the trains of this company and those of the subways and elevated and surface railways will be afforded at the Grand Central Station, and also at several exterior points north of the Harlem River.

"From these proposed improvements thus briefly outlined, the railroad company anticipates a marked increase in the comfort and safety of its passengers, and consequently a decided increase in suburban business. Property abutting on the railroad will naturally increase in desirability as a result of the withdrawal of the annoyances unavoidable in the operation of the steam passenger locomotive. The beautiful territory along the Hudson and Bronx Rivers and Long Island Sound, under these favorable conditions, will grow rapidly in popularity for homeseekers, to the mutual advantage of the railroad company and of the public. What is also of great importance, the adoption of electricity, makes possible the future reclamation of between 30 and 40 acres of overhead space in the territory occupied by the terminal yard in the heart of the city of New York, which, instead of being left open as required with steam operation, may be utilized by the company for superimposed structures in any manner best suited for its purpose."

In connection with the above data from Mr. Wilgus, particulars are now given out as to the new Manhattan Island terminal of the New York Central, which will be at once the largest and the first electric railway main line terminus in the world. It will be replete with electrical features of novelty and ingenuity. The station is designed to meet the requirements of three great railroads, and will, it is believed, with its separate levels for express and local trains, have facilities for handling more passengers than any terminal now built or designed. There will be a subway cab stand, where incoming passengers may find conveyances for themselves and their baggage. Access to the rapid transit subway will be provided underground. Dressing rooms will be provided so that out-of-town residents may change from business suits to evening clothes without going to hotels. Some of the dressing rooms will have connecting baths. There will be dressing rooms for women as well as for men, and special parcel checking rooms will be attached. There will be a small hospital in the station, with a physician in attendance. This will be a new feature in railroading.

There will be barbers, hairdressers and manicures in the station, also the usual newsstands, telephone and telegraph offices. There will be a ladies' tea room, on a larger scale than the one in the present station, and adjoining the smoking room will be a buffet and lunch counter for men.

Carriages arriving at the station may stop in Forty-second Street, east of the main entrance, where a space 40 ft. in width is provided. If there should be congestion at that point room may be found in Vanderbilt avenue on the west side of the station. The station will stand 70 ft. back from the Vanderbilt avenue line, and that thoroughfare will be a plaza 130 ft. wide. This additional space has been allowed in order to relieve the present congestion of vehicles and pedestrians around the station. Passengers entering the proposed new station will find themselves in a ticket lobby 90 by 300 ft. This will be on a level with the street. In the center of the room will be a ticket office 200 ft. in circumference.

Near the ticket offices will be the parcel checking room, which will open on the three levels of the station. Baggage may be checked on the east side of the ticket lobby. Outgoing baggage will be received on the east side of the station, in Depew Place, and incoming baggage will be delivered on the opposite side of the building. Belt conveyors driven by electric motor will take trunks from the cab stand and carriage entrances to the car platforms. From the ticket lobby four flights of stairs, each 25 ft. wide, lead down 15 ft. to the express track level. The stairs lead to a concourse 160 by 470 ft. On this level there will be twenty-two express tracks, two for baggage, two for mail cars and eight for merchandise by express. From the concourse a vamp or incline will extend to Madison Avenue. Wide flights of stairs will lead to the level of the suburban trains directly under the express tracks. On this level there will be ticket offices and all the appurtenances of a railroad station, so that a complete separation of express and local traffic will result. Within the loop for suburban trains will be "island" platforms, from which either local or express trains may be taken to nearby points. One group of trains on the New York Central will go to Yonkers, another to Tarrytown and another to Croton. At each of these towns there will be loops, so that the trains may return without being switched across express tracks.

The multiple-unit system of electric propulsion will be installed for the suburban traffic, and each car may thus be handled separately. Storage for 120 cars will be provided by spurs leading from the loop at the Forty-second Street terminal. This will permit cars to be run into the city in the morning and held until needed in the evening. The present system of sending trains empty to Mott Haven to be cleaned will be abandoned and a compressed air cleaning plant will be installed at the new terminal.

There will be four floors for offices in the new station, a total of 250,000 sq. ft. of office space being provided. At present from 550 to 600 trains enter and leave the Grand Central Station daily and 30,000 persons pass through the station. The new terminal is designed to accommodate 3,000 trains daily and 150,000 to 200,000 passengers.

The total outlay is estimated at $17,000,000 for the station proper and $25,000,000 for terminal improvements.

St. Joseph River Power Development.

THE already extensive Northern Indiana hydro-electric power system will be able, when ultimately completed, to furnish energy to the cities in the St. Joseph River Valley from almost the entire "drop" of the St. Joseph River, from Mottville to Lake Michigan. The river power will then be utilized from nine dams, aggregating about 115 ft. fall and having a watershed above the last dam of approximately 3,600 square miles. The distance from the uppermost dam to the one nearest Lake Michigan will be upward of 60 miles. Between the two extremes the river flows through one of the most active manufacturing regions in the country, containing a prosperous population of 125,000. Benton Harbor, St. Joseph, Buchanan, South Bend, Mishawaka, Elkhart, Niles, Goshen and other places will be served.

The largest installation so far in operation is the Twin Branch plant, the property of the St. Joseph & Elkhart Power Company. It is located on the St. Joseph River, seven miles east of South Bend and ten miles west of Elkhart. Its present capacity is 4,000 kw, to be increased later on to 6,000 kw. The Twin Branch plant was designed and built by the New York electrical engineering and contracting firm of Sanderson & Porter.

The dam is 400 ft. long, with a combined base and apron 145 ft. wide. The structure of the dam is 30 ft. high from bottom of timbering and develops about 20 ft. head with flashboards. Some 3,000,000 ft. of lumber and 125 tons of bolts and spikes were utilized in the construction of the dam and apron.

The power house is situated at the south end of the dam and runs parallel with it. The building and forebay measure 180 ft. long and 130 ft. wide and are built throughout of concrete and steel. There are 14 sluices. The crowns of the arched top of the sluices are 3 ft. thick and form the floor of the generator room and wheel forebays. Each unit is set in an independent compartment, controlled by a series of gates operated by electric power. There are five water wheels in each main unit mounted on a horizontal shaft 11 in. in diameter and about 60 ft. long. This shaft passes through the bulkhead wall and is direct-connected to an alternating-current, 1,000-kw, three-phase, 60-cycle electric generator.

The turbines are of special design with steel plate runners and were built by the Trump Manufacturing Company, of Springfield, Ohio. The heavy wheel bases, wall frames, etc., were made by the Webster Manufacturing Company, of Chicago. J. M. Matthews, of South Bend, Ind., supplied the draft tubes and the generators, switchboard and other electric equipment were manufactured by the Westinghouse Electric & Manufacturing Company.

The Buchanan plant, also located on the St. Joseph River, about a mile distant from Buchanan, is the property of the Buchanan Company. In the near future it is expected that it will be capable of developing twice that energy. The dam is 398 ft. long and maintains a 12-ft. head of water. The power house, which is situated just below the dam, is 275 ft. long and 35 ft. in width. The equipment consists of ten 68-in. water turbines, built by James Leffel & Co., of Springfield, Ohio. These turbines drive a 1,500-kw, three-phase, 60-cycle, 2,300-volt generator of General Electric make. Transformers step up this current to a pressure of 25,000 volts for transmission to South Bend.

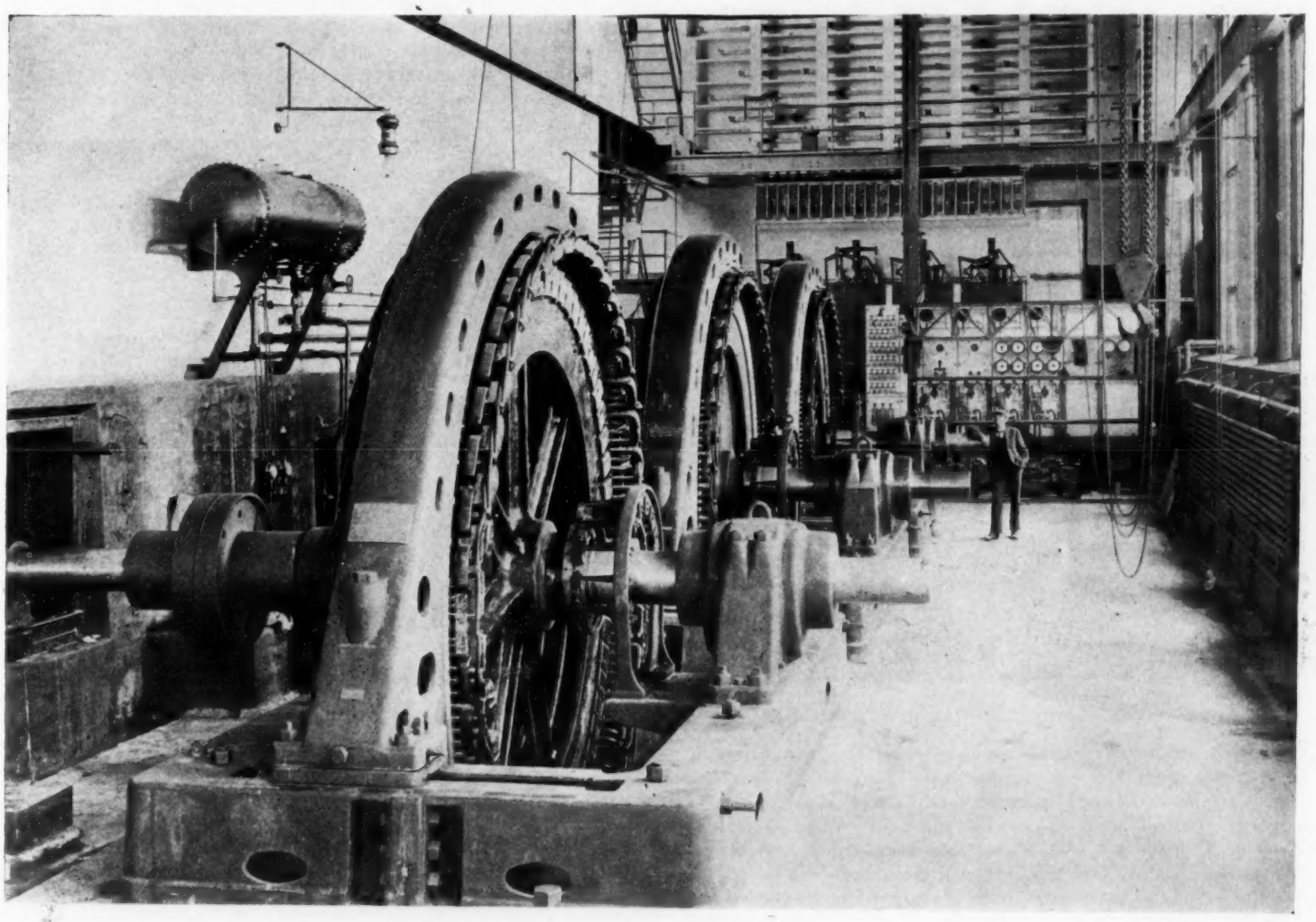


FIG. 1.—GENERAL VIEW OF INTERIOR OF POWER HOUSE, ST. JOSEPH & ELKHART POWER COMPANY.

Power contracts have been negotiated between the St. Joseph & Elkhart Power Company, proprietor of the Twin Branch plant, and the South Bend Electric Company, whereby the latter company acquires the surplus power of the former. The arrangement means that the promoters of the dam enterprise have decided to let their franchise received in South Bend under the name of the South Bend Electric Company go by default and furnish all the electrical energy after providing for Elkhart, Mishawaka and the intervening points to the South Bend Electric Company for South Bend use.

The Buchanan hydraulic development is now furnishing power to the South Bend Electric Company under similar conditions. As a result of this arrangement, all the important electric power plants in the valley of the St. Joseph River will be operated in harmony.

This system will result in better and more reliable service in view of the fact that the hydraulic projects at Elkhart, Twin Branch and

Buchanan will be connected electrically, and relayed by steam power at Elkhart and South Bend. Should any unforeseen trouble happen

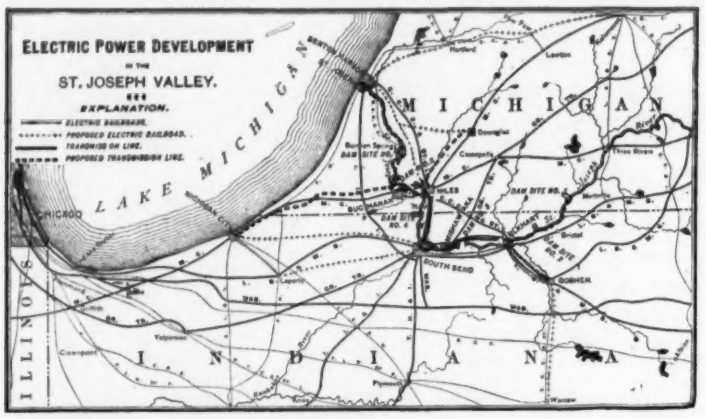


FIG. 2.—MAP OF TERRITORY SERVED.

at the Buchanan plant, customers receiving power directly from there will be immediately switched upon the Twin Branch plant and vice versa. Should the Twin Branch plant be impaired at any time, those receiving current normally from this installation will be promptly connected with the Buchanan plant.

A steam plant of 2,500 hp capacity is maintained at South Bend as a relay for the hydro-electric equipment at Buchanan and Twin Branch. The building that houses this steam equipment acts as a sub-station for the high-tension lines from the two dams. The current is there stepped down from 25,000 volts and 13,000 volts to 2,300 and delivered throughout the city. A similar steam plant and sub-station is in operation at the Elkhart end of the line.

The South Bend Electric Company is entering the field with a view to furnishing power to as many manufacturing establishments as possible. South Bend is the center of distribution of the St. Joseph River Valley system and is about 90 miles east of Chicago by the main line of the Lake Shore & Michigan Southern Railroad, the Grand Trunk Railway, of Canada, and other lines. Its population is about 35,000. Contracts have already been made among several of the principal manufacturing plants in South Bend and vicinity for the supply of power.

The arc lighting contract which is held by the South Bend Electric Company for a period of 10 years from January 1, 1905, will be supplied by new equipment. This apparatus consists of 450 alternating-current enclosed arc lamps with regulators and step-up transformers and has been contracted for with the Adams-Bagnall Electric Company, of Cleveland, Ohio. Power for the system will be furnished through two banks of transformers, consisting of three 500-kw General Electric make and a similar number of Westinghouse machines of similar capacity, which will reduce the transmission line e.m.f. of 25,000 volts from Buchanan and 13,000 volts from Twin Branch to 2,300 volts, 60-cycle, three-phase on the bus-bars at the South Bend sub-station. This sub-station receiving current from the before-mentioned two sources will also be supplied with current at some future time from a prospective hydro-electric development some ten miles below Buchanan on the St. Joseph River.

The sub-station in the city of Elkhart is served from the plants named above and will later be also supplied by a hydro-electric development on the St. Joseph River above Elkhart. It is expected that this system now operating the hydraulic plants at Buchanan, Twin Branch and Elkhart, also the relay steam plants at South Bend and Elkhart, will be still further supplemented from time to time by additional power derived from other future hydro-electric developments. The owners of these properties intend to spare no effort to convert as much as possible of the power of the St. Joseph River into electricity for transmission in such manner as the power requirements of the St. Joseph River Valley call for.

The South Bend Company has fixed rates for power based on a service charge and an energy charge. Power is supplied at a price considerably below that which it can be delivered by steam under the most favorable conditions with cheap coal. A comparison of the power rates with those offered by a large Western city indicates that the figures are about 50 per cent. in excess of the St. Joseph Valley power system. This cheap power is coupled with exceptionally complete railroad and transportation systems, and these will soon be added to by a number of electric railway propositions now building or contemplated.

So far the St. Joseph Valley power system has entailed an expenditure of fully $5,000,000. The parties primarily interested in the properties are Mr. Charles A. Chapin, of Chicago, and the owners of the St. Joseph & Elkhart Power Company. The operation

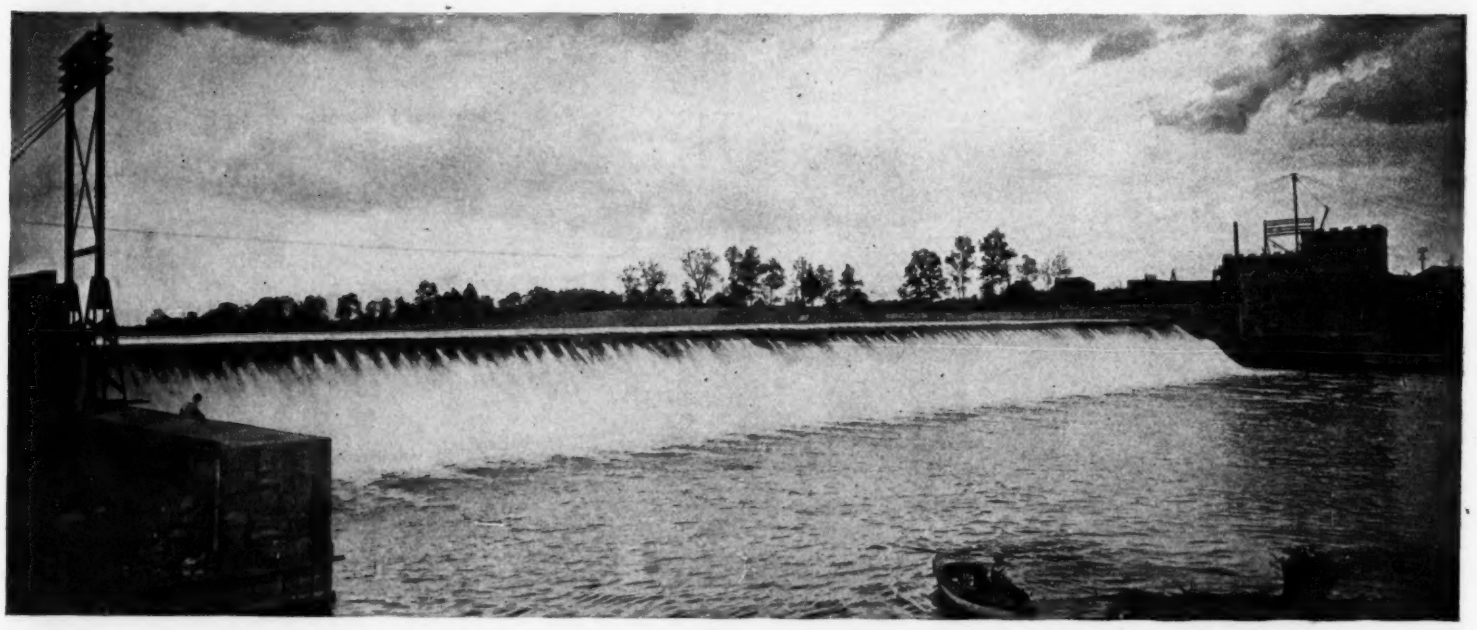


FIG. 3.—VIEW OF DAM OF ST. JOSEPH & ELKHART POWER COMPANY, FROM NORTH BANK OF ST. JOSEPH RIVER.

FIG. 4.—POWER HOUSE AND DAM.

of the system is in the hands of Mr. F. A. Bryan, of South Bend, general manager, while Messrs. Sanderson and Porter are the consulting engineers.

Some Latest Features of Automatic Telephony.

BY NORMAN G. MEADE.

THE Automatic Electric Company's system of telephony embodies many novel features, both mechanical and electrical. The articles that have appeared in technical journals on this subject have been devoted chiefly to general descriptions of telephone exchanges. It is the purpose of the writer to explain the more important points of the present automatic system, with the aid of diagrams showing the various circuits and details.

A plan of a 10,000 subscriber power board is shown in Fig. 1. It is equipped with the usual instruments, such as switches, fuses, a circuit-breaker, volt and ammeter, with the addition of generator lamps and tell-tale relays and lamps. The details of this board will be taken up in connection with the diagram of its circuits, which are shown in Fig. 6, together with the interrupter, howler and busy circuits and their connection to the system. The capacity of the motor-generators, ringers and other machines depends, of course, on the number of subscribers cared for.

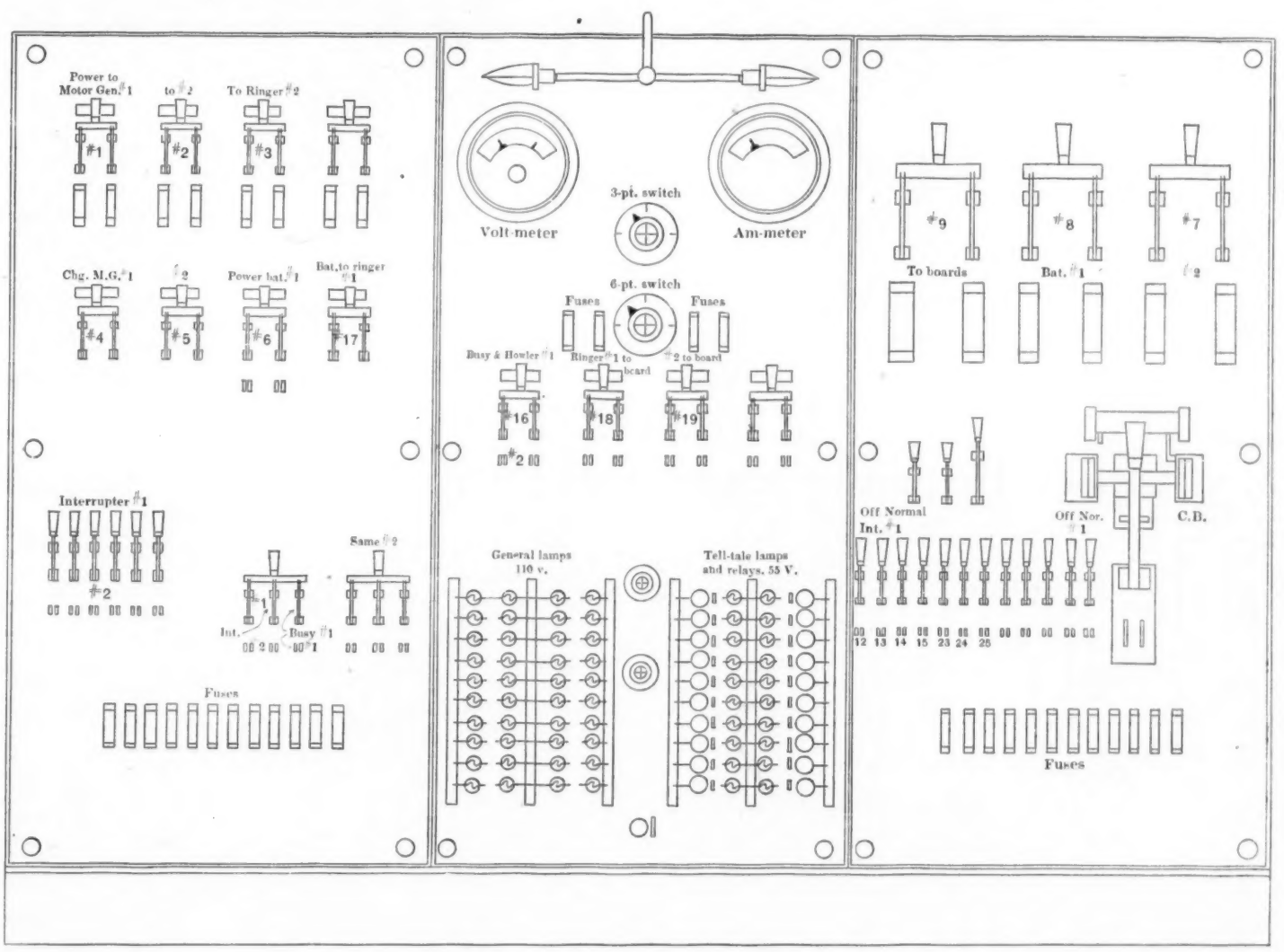


FIG. 1.—PLAN OF 10,000-SUBSCRIBER POWER BOARD.

It will be seen by reference to the diagram that the motor-generators are supplied with alternating current from the power bus-bars, which are connected to the local lighting company's circuits. One ringer, also, is supplied with alternating current.

The circuits for charging the storage batteries, shown at the left side of the figure, are easily traced. A circuit-breaker with both overload and no-load attachments is placed in connection as shown. A six-point switch connects the ammeter with the charging and discharging circuits. Either one of the motor-generators can be thrown in circuit with the storage batteries, which are arranged in two groups. The numbers opposite the switches in Fig. 6 correspond to the numbers in Fig. 1. The main battery tell-tale is shown at the lower left-hand corner of the board, and is connected to the battery bus-bars by switches numbered 24 and 25.

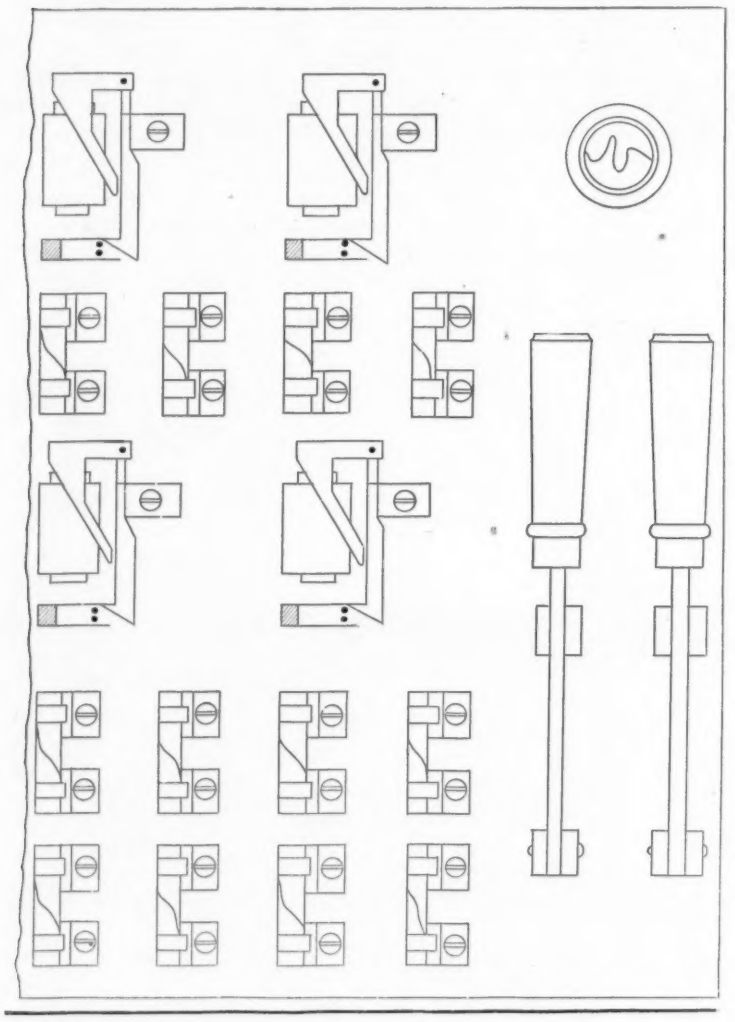
The automatic switches are protected by Cook heat coils so arranged that the circuit is closed through the tell-tale relay when a coil "blows" (see Fig. 5). The relay is connected to the ground battery and to the main battery tell-tale wire. When the circuit is closed through the relay its contact springs close the circuit through a 110-volt miniature lamp, and this in turn operates a second relay that throws the generator in connection with a magneto extension bell, shown by the diagram in Fig. 6. A tell-tale relay and lamp are provided for each 100 group of automatic switches, and are mounted on the powerboard as shown in Fig. 1. A second tell-tale lamp is mounted on each shelf of every 100 group and connected in series with the relay. When a heat coil "blows" the exchange attendant is immediately notified by the bell. He glances at the board and notes which hundred group the lighted lamp indicates, then goes to that group and finds the shelf the trouble is on by means of the second tell-tale lamp. The defective coil is thus quickly and easily located.

Two 110-volt lamps are connected in series with the generator circuits leading to each group of switches. These lamps do not light unless there is a short-circuit or ground.

The interrupter is used for giving a vibratory motion to the rotary magnet armature on the first selector. By reference to the diagram it will be seen that the interrupter consists of several sets of spring contacts which are normally closed. A semi-circle of hard fibre, with beveled edges and attached to the motor shaft, causes the springs to be separated during one-half of each revolution of the motor, which is generally speeded to about 1,000 r.p.m. One interrupter spring is connected to the ground through the ground battery bus-

bar, and to the main battery through the rotary magnet of the first selector. It is customary to have one set of springs for each 1,000 first selectors.

The howler is mounted centrally on the interrupter motor shaft. It consists of a brass wheel with pieces of fibre inlaid in the periphery in such a way that they form a succession of broken contacts for the brush which rests on its surface. A second brush bears against the side of the wheel and a condenser is connected across the two for softening the effect of the rapid interruptions of the circuit. When the howler is connected to a telephone receiver it howls with a noise similar to that of a whistle. This effect is caused by the rapid vibrations of the diaphragm of the receiver. The howler circuit leads to a switch on the wire chief's desk and is turned onto a subscriber's



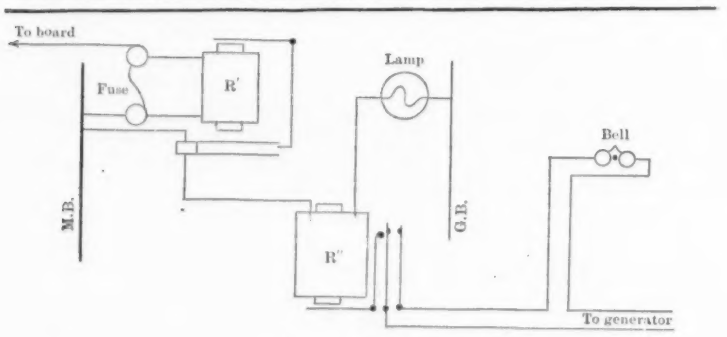


FIG. 2.—FUSE BOARD.

circuit, who fails to hang up his receiver after talking. This notifies the party, in a forcible manner, to replace the receiver.

The busy-buzz device is similar in construction to the howler, and is geared to the interrupter shaft as shown in Fig. 2. This wheel, however, has only about two-thirds of its periphery inlaid with fibre pieces, making one long contact followed by a succession of short ones. Dry cells are used for the busy, and the main battery conductor is used for the return. When a subscriber calls and the party called is using his telephone the calling party on pushing the button will get the busy in his receiver, which gives a soft buzz-z-z, buzz-z-z.

A fuseboard for each 1,000 group is provided, and is shown in Fig. 2. It is equipped with fuse clips and fuses, relays and single-pole switches for main battery, ground battery, interrupter and busy. An incandescent lamp is mounted upon the board to indicate the location when a fuse blows. The relays are shunted across the fuse terminals and release the contact spring underneath them, closing the circuit through the lamp and a ringing relay. This arrangement is

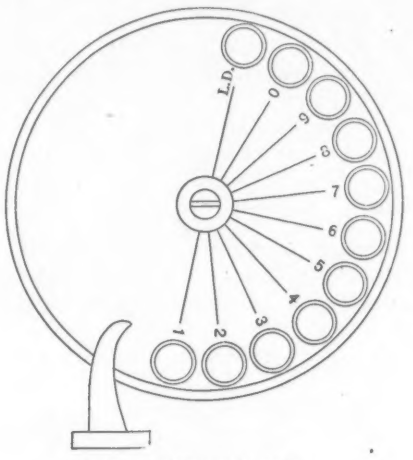


FIG. 3.—CALLING DIAL.

similar to the one on the powerboard. The fuses of the lower row are for the interrupter and are not provided with tell-tales. Each 100-group battery circuit is fused.

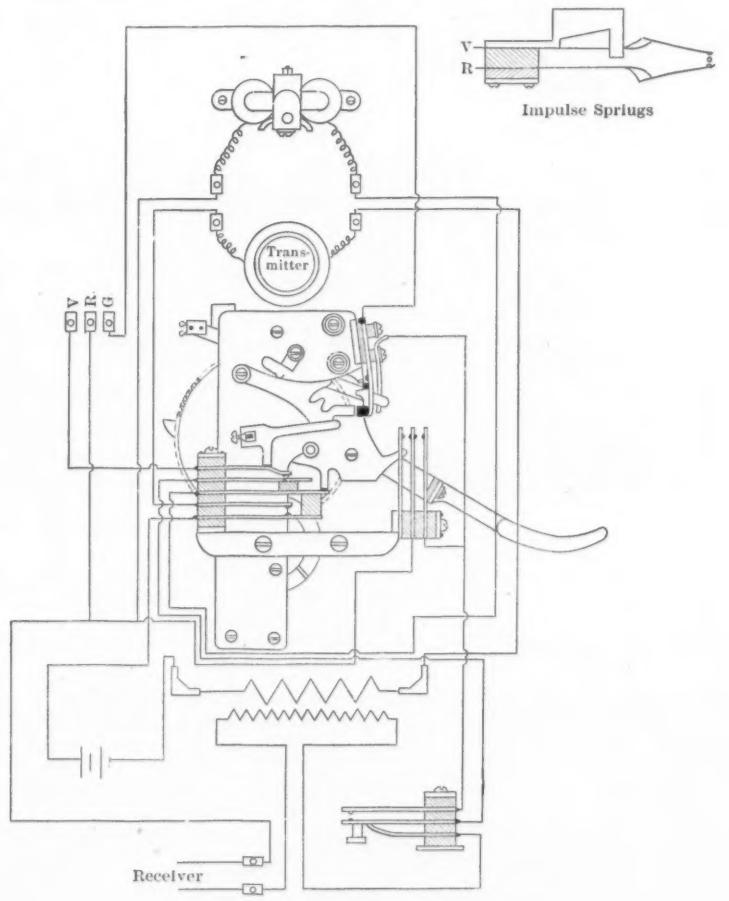


FIG. 4.—CIRCUITS OF WALL INSTRUMENTS.

Fig. 3 represents the calling dial, which has a long-distance connection that, with one turn, connects the subscriber directly with the tollboard. Fig. 4 shows an interior view of a wall instrument and its circuits. A wheel with a series of projections corresponding to the dial numbers and operating simultaneously with the dial forces the impulse springs against the ground contact. The calling circuit has a ground return, while the talking circuit is metallic. The ground to the instrument is open until the dial is moved, when a spring is released, making contact. This arrangement becomes necessary, as otherwise any person pushing the calling button on the instrument would raise the first selector in the exchange. On hanging up the

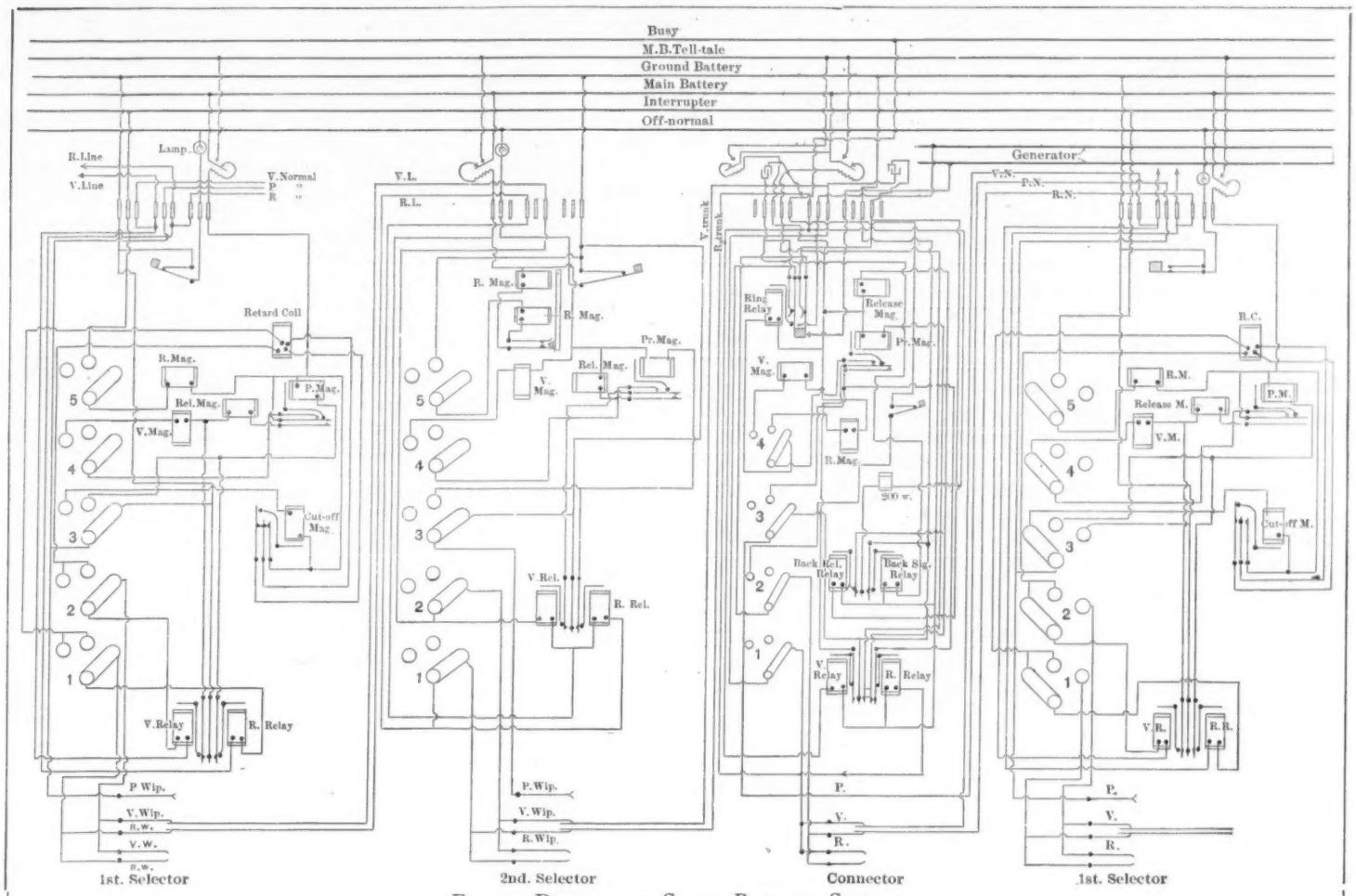


FIG. 5.—DIAGRAM OF SERIES BRIDGING SYSTEM.

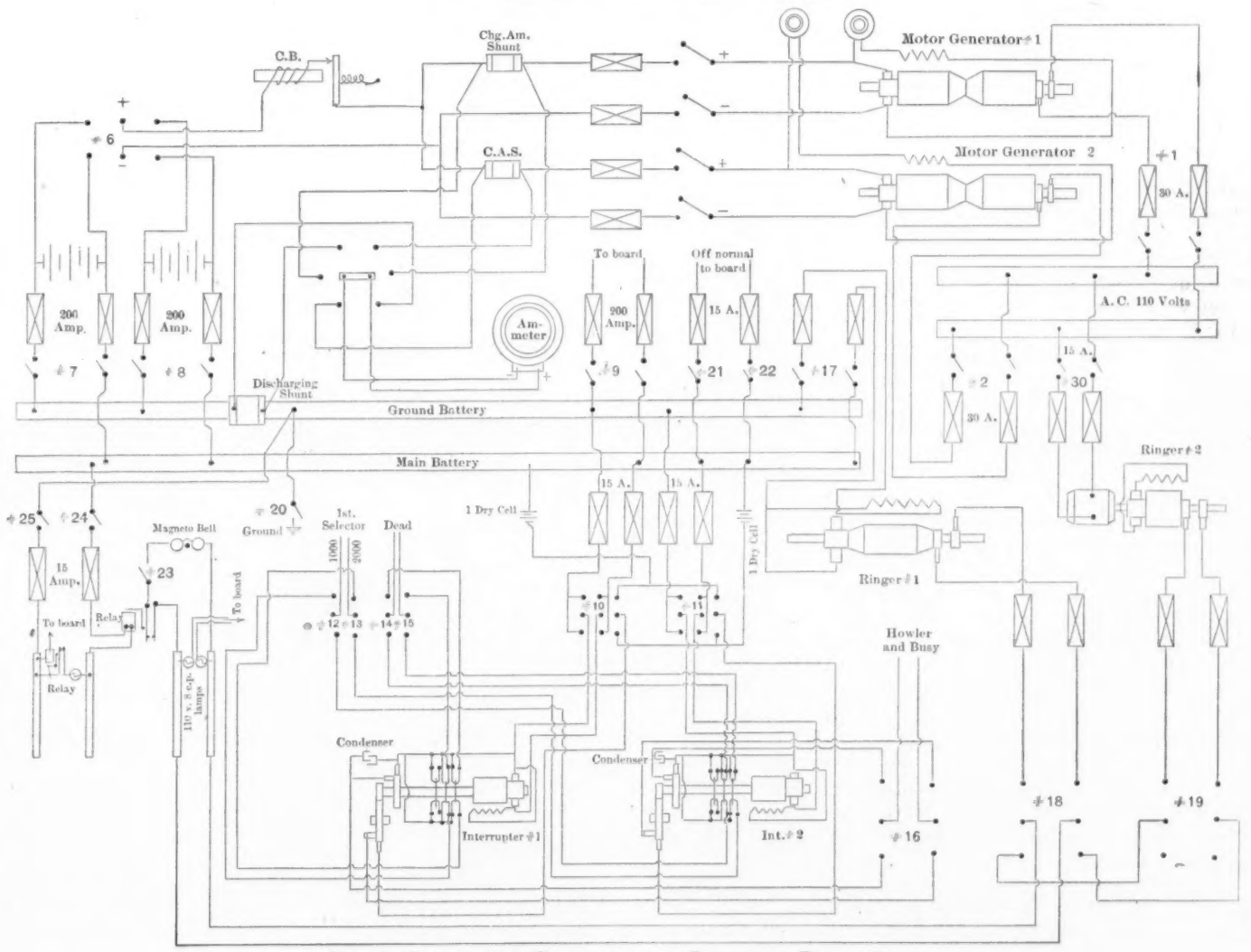


FIG. 6.—DIAGRAM OF CIRCUITS, 10,000-SUBSCRIBER POWER BOARD.

SOME LATEST FEATURES OF AUTOMATIC TELEPHONY.

receiver the hook grounds both rotary and vertical lines momentarily, thus releasing the automatic switches.

Fig. 5 is a diagrammatic view of the series bridging system, showing the position of the switches when the party on the left has called the party whose first selector is at the right. The compound side switch on the different switches is represented as separate units for the sake of simplicity.

We will assume that *A* at the left wishes to call *B* at the right, whose number is 1857. All the side switches are in their normal necting the interrupter to the rotary magnet and turning the switch position; that is, on the left-hand contact. *A* moves his dial from the figure 1, thus raising his first selector one notch. The movement of the dial grounds the rotary side of the line immediately after the vertical is grounded, closing the circuit through the private magnet, releasing the side switch, which swings to the center position, conwipers around to the first contact. A trip attached to the rotary armaure operates also the side switch, which passes to the third position, connecting the first to the second selector. If the first contact is busy it will be grounded in the private bank, thus closing the circuit through the private magnet and keeping the interrupter on the rotary until the wipers pass to a contact that is not busy. The private magnet also cuts the battery off the vertical magnet and throws it on to the release magnet. The retard coil is a simple resistance coil with two windings. When *A* hangs up it operates both rotary and vertical relays, closing circuit through the private magnet, which throws ground and main battery on release magnet, dropping switch to its normal position. The off normal switch shown near the top of the first selector closes when the wipers are up, lighting a lamp on the shelf with the selector. The second selector operates in a similar manner to the first, save that the rotary makes its own interruptions.

By moving the dial from 1, *A* is connected to the second selector. He now moves his dial from 8, raising the switch to the eighth row of contacts, when the rotary impulse will rotate the switch in, connecting him to the connector in the 1,800 group. The two last figures connect *B*'s first selector in circuit by means of the connector. *A* now moves his dial from 5, raising the connector switch five points. The rotary impulses throws the side switch to center, connecting the rotary magnet in circuit. He moves the dial from the last figure of the number, which is 7, rotating the connector to the seventh horizontal contact. As each connector contact represents one first selector, the rotary motion of the connector is by impulse. A certain number of impulses carries the wipers an equal number of contacts inward.

Having moved the dial the requisite number of times, *A* pushes his button, the side switch having in the meantime passed to its third position. Pushing the button operates the ringing relay, calling *B*. *B's* switch does not move, with the exception of the cut-off magnet, which disconnects battery from the relays. If *B* is busy the connector will release and drop. The pushing of the button by *A* will raise the connector switch and close the busy; he will then get the buzz which indicates that *B* is busy and will hang up.

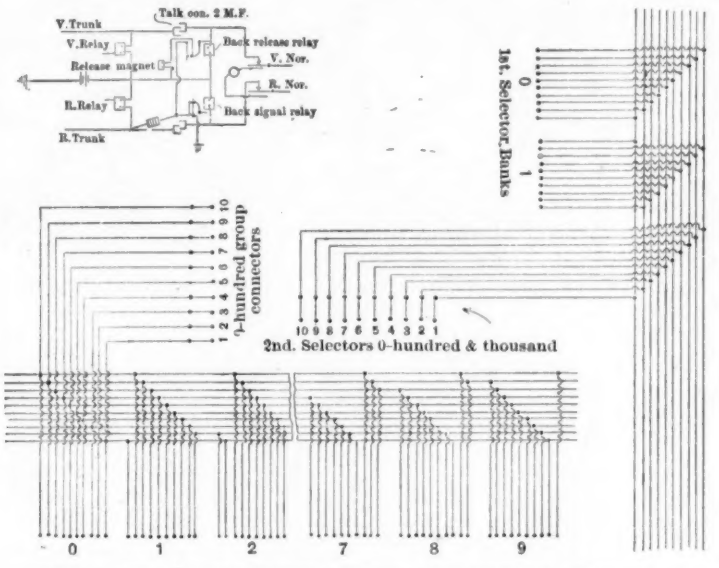
The busy switch is similar to the off-normal switch of the first and second selectors, and operates in the same manner.

If *B* should move his dial after he had answered his call and hung up his receiver it would operate the back release relay, dropping the connector to its normal position. *A* would then push his button again to arouse *B*, and would get the "busy." He would then have to hang up and call again. The back signal relay operates a signal on the toll-board when an automatic subscriber hangs up his receiver after talking with a long-distance or rural subscriber having an ordinary telephone. Fig. 7 shows the connector circuit when in a talking position.

Automatic exchanges are generally arranged with the 100 groups ten in a row, front to back, forming a thousand group. As an exchange of 1,000 subscribers and over calls with four numbers, the 100 groups are numbered naught-hundred, eleven-hundred, twelve-hundred, etc. In a full 10,000 subscriber exchange the same arrangement would necessarily have to be made, numbered naught-thousand, one-thousand, two-thousand, etc. The one-thousand board takes care of the numbers from 1,000 to 1,999. The tenth board would be the naught-thousand, taking care of numbers from 0000 to 0999. A board for more than 10,000 subscribers would require the use of five figures for calling.

Each 100 group of first selectors is arranged on four shelves of 25 each. The shelves are held by an iron frame. Above the first selectors are mounted the second selectors and connectors, ten of each, thus providing for ten subscribers calling at one time in each 100 group. This is considered to be the maximum number of calls that will come in a group at one time, but if necessary the trunking capacity can easily be increased by adding trunking switches.

The banks of contacts in each group of first selectors are in straight multiple and are connected to a distributing board. The connectors and second selectors are likewise multiplied and connected to distributing boards. The second selectors are multiplied from one 100-



FIGS. 7 AND 8.—CONNECTOR CIRCUIT AND SELECTOR CIRCUITS.

group to the next in each 1,000-group. This is not straight multiple, however, as the contacts slip back one in each hundred, as shown in Fig. 8. A 1,000-group of second selector banks is shown diagrammatically, the sketch representing one row of contacts only. This arrangement of slipping back is to prevent corresponding contacts in each switch from being busy if one switch is in use, thus equalizing more fully the work of the switches. The first selector banks are multiplied from thousand to thousand, corresponding hundred groups being connected together. The same slipping arrangement is used throughout. Each horizontal row of contacts on the rotary and ver-

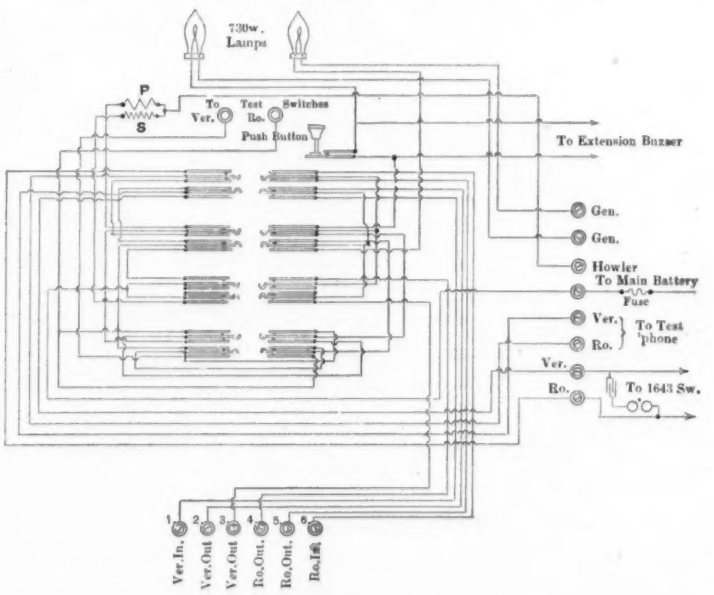


FIG. 9.—DISTRIBUTING RACK TEST SET.

tical banks of the second selectors represent the connectors in the corresponding hundred group in each thousand.

The connectors are connected to the second selector wiring in this order, as shown in the figure. Assume that number 1,000 wishes to call 1001. The first contact of the first row in the naught-hundred group would be the one taken by 1000's first selector if not busy. This will connect with second selector No. 10 in the same group, also with connector No. 10, which will connect with No. 1001. If 1999 were the number called, the first selector of 1000 would connect with

the ninth row of contacts in the second selector, which would pick out a connector in the 900 group. The second selectors are connected with the first selector banks in the same manner, in which the connectors are connected with the second selector banks.

In a 10,000 subscriber exchange the first row of contacts in the first selectors represents the 1,000 group, the second row the 2,000 group, etc.

Fig. 9 shows the connections of a testing set that is mounted in a small box and attached to the test telephone in the exchange. Three double-acting levers, similar to those used on a manual board, project from the upper side of the box. By a forward or a backward movement of the levers different combinations are obtained. This arrangement is convenient for taking care of "troublemen" outside, who are calling in for tests and instructions.

Morgan's Falls, Ga., Transmission Plant.

BY LAMAR LYNDON.

THE hydro-electric plant lately put in commission by the Atlanta Water & Electric Power Company, at Morgan's Falls, Ga., costing as it did nearly a million and a half dollars, and having a capacity of 14,000 hp, is notable in that it marks the beginning of an era of large water power developments in the South.

For many years industrial investments below the Mason and Dixon line were considered hazardous and insecure. A gradual change in the sentiment among Northern capitalists has, however, taken place, and as one of the results of this altered attitude the Morgan's Falls plant stands to-day a finished work.

The power station is located on the Chattahoochee River, 18 miles above Atlanta, to which city all the power generated is transmitted. Construction was begun in September, 1902, and finally completed in October of the present year, when current was carried into Atlanta and there delivered to the mains of the Georgia Railway & Electric Company, which company has contracted to take the entire output of this power plant. Fig. 1 is a map which shows the location of the station with reference to the city of Atlanta.

THE DAM.

The dam foundation rests upon and abuts at both ends against ledge rock. The spillway is 700 ft. long and the bulkhead is 200 ft. long, making a total length of 900 ft. The dam is straight and runs at right angles to the channel of the river.

The height of the spillway portion is 48 ft., while the height of the bulkhead portion is 58 ft., rising 10 ft. above the crest of the dam. The spillway is straight on its upstream face, having a batter of 0.20, and is curved on the downstream side. The thicknesses of the spillway portion are as follows: Eight feet below crest, 15 ft.; base

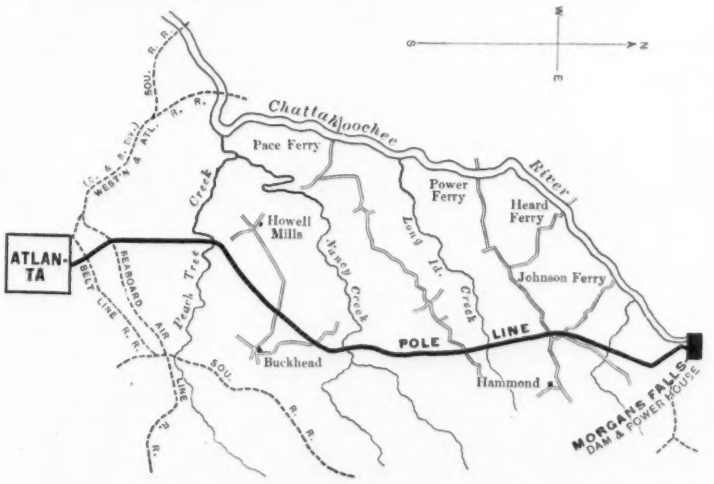


FIG. 1.—MAP SHOWING STATION AND LINE.

of dam, 43 ft., exclusive of toe; base, including toe, 62 ft. A cross-section of the spillway is shown in Fig. 2.

The dam is built of cyclopean masonry, constructed of large stones laid up in concrete. The upstream face is of rubble masonry laid in Portland cement, while the downstream side is finished with Portland cement concrete. All rock used in the dam was taken from quarries at the point of erection.

The form of the bulkhead portion of the dam is shown in Fig. 3, and the dimensions are given in the diagram. The usual trash racks and head gates are located on the upstream side of the bulkhead. There are three waste pipes in the bulkhead, each 6 ft. in diameter, which serve to reduce the amount of water flowing over the crest of the dam during times of heavy floods.

A tail-race, 300 ft. long, was blasted out of the rock below the dam, and a low wing wall, which runs 150 ft. down from the power house, keeps the waste water from overflowing into it. About two feet additional head on the turbines were thus obtained.

POWER HOUSE.

The power house rests on nine heavy piers, each of which is 5 ft.

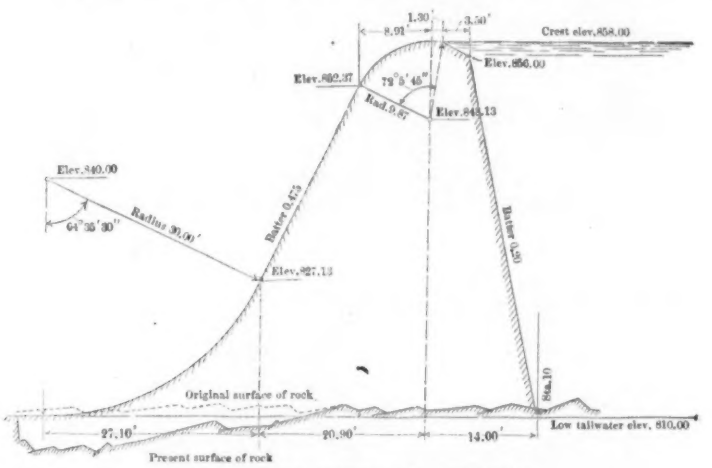


FIG. 2.—CROSS-SECTION OF SPILLWAY.

thick, and runs through the entire width of the building. These piers connect with, and in reality form extensions of, the downstream side of the bulkhead. Between these piers are the eight tail-race openings, of which seven are for the main units and the one near the middle for the two exciter sets. Above these piers rises the building, which is 196 ft. long, 40 ft. wide, and 28 ft. 9 in. inside height of walls. The floor is 29 ft. below the crest of the dam.

The structure is of fire-proof construction, the walls being of brick laid in Portland cement mortar, the floor of concrete, finished in cement granolithic, and the roof of cement and cinder concrete reinforced with steel and supported by steel trusses.

GENERATING EQUIPMENT.

The electric generators are seven in number, with two exciters. Each of the main generators is a 1,500-kw, three-phase Westinghouse revolving-field machine, running at 187½ r.p.m., and delivering current at 2,200 volts. The frequency is 25 cycles per second.

These dynamos have 16 poles, which rotate in the field gap.

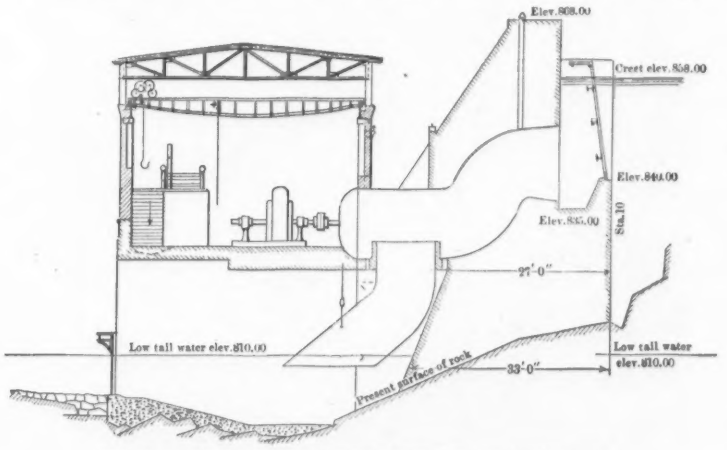


FIG. 3.—CROSS-SECTION OF BULKHEAD, STATION, ETC.

These poles are of soft laminated iron, the laminæ being so arranged as to break the joints, making the built-up structure practically an integral, homogeneous mass of annular form, the poles projecting outward from the periphery. Dove-tail pieces project radially inward from this laminated ring, which fit into similarly shaped recesses in the periphery of the cast-iron spider. In this manner a substantial and solid construction is obtained.

The armature windings are distributed and placed in slots, which are formed in the laminated stationary structure. The windings are so proportioned as to give an inherent regulation of 6 per cent. The efficiencies of these generators, including exciting energy, are as follows: ½ load, 91¼ per cent.; ¾ load, 93¾ per cent.; full load, 95 per cent.

There are two independent exciters, each of 150 kw capacity, which rotate at a speed of 450 r.p.m. These are standard Westinghouse 125-volt, direct-current generators. The exciters are placed side by side, near the middle of the length of the power station, three of the main generators being on one side and four on the other. Either exciter is of sufficient size to furnish full-load exciting current to all the generators, so that one is a spare unit. Both are, however, run alternately, so that either is always in proper condition to take up the exciter load.

The prime-movers are horizontal turbines, built by the S. Morgan Smith Co. Each main generator is direct-connected to a pair of 48-in. wheels, mounted on a single horizontal shaft, the generator and turbine shafts being joined by a flange coupling. The wheels are of the McCormick inward-flow pattern, and guaranteed to give 80 per cent. efficiency at full load, under a 48-ft. head. Each pair of wheels is mounted in a penstock 12 ft. in diameter, made of 5/16-in. steel plate. The discharge from each pair of turbines passes out through a single draft tube, 10 ft. in diameter. The number of units in operation will vary with the volume of water in the river and the requirement of the load, the entire seven being required at times. Each exciter is driven by a single horizontal turbine 12 in. in diameter, to which it is directly connected. These small turbines are encased in penstocks 3 ft. in diameter, made of 3/16-in. plate, and the discharge takes place through a draft tube, 3 ft. in diameter.

All penstocks are carried back directly into the bulkhead, as is indicated in Fig. 3, which shows a cross-section through the power station and bulkhead. An air vent 6 in. in diameter is tapped into each penstock at the bulkhead, and these vents are extended by means of 6-in. pipe to the top of the bulkhead.

Speed control is effected by Ellicott hydraulic governors, one being attached to each machine. Electrical attachments admit of controlling the speed of any unit from the switchboard.

A twenty-five-ton traveling crane spans the width of the building, and in addition to the usual heavy lifting apparatus is equipped with a quick-acting one-ton hoist for handling smaller parts rapidly.

Back of the bulkhead, and between it and the power house, runs an overhead traveling crane of three tons capacity, designed for handling the water wheel parts, the wheel cases having large working openings cut in them at this point, which are normally closed by large manhole covers.

SWITCHBOARD AND CONTROL.

The current from the generators passes to the oil circuit-breakers, which are located just underneath the switchboard gallery. The conductors which carry this current are paper-insulated cable of 1,000,000 circular mils cross-section, two in parallel. They are laid in vitrified tile conduits, which are embedded in the station floor. The cables are the standard high-tension type, made by the National Conduit & Cable Company.

The oil circuit-breakers have fire-proof barriers between adjacent terminals, and controlled from the switchboard above. They are separated from the rest of the station by means of a wall of white, glazed brick, which also serves to support the switchboard gallery. The accompanying illustration shows the mechanism and method of mounting these breakers.

From the main oil circuit-breakers the current is carried to the step-up transformers. There are seven of these, each of 1,500 kw capacity, with a ratio of transformation of 10 to 1. They are all of the oil-insulated type, and cooled by circulating water, which passes through a cooling coil immersed in the oil. Only six are required for the normal station load, the seventh being held in reserve.

From the step-up transformers the current, now raised to a potential of 22,000 volts, goes to the high-tension oil circuit-breakers, which are located in the tower from which the transmission lines pass out. These circuit-breakers are controlled from the switchboard by means of solenoids, which are operated by direct current taken from the exciter circuits. The switchboard consists of twelve panels of blue Vermont marble, and two swinging panels—one at either end of the board. The first two panels are exciter panels and each carries a 2,000-amp., direct-current ammeter, a 1,500-amp., direct-current circuit-breaker, a 150-volt voltmeter, an exciter field rheostat, a voltmeter plug receptacle and three single-pole, single-throw, 1,600-amp. switches. The connections are such that either exciter may supply field current to any or all of the main generators, or the two exciters run in parallel may excite the fields of the main generators.

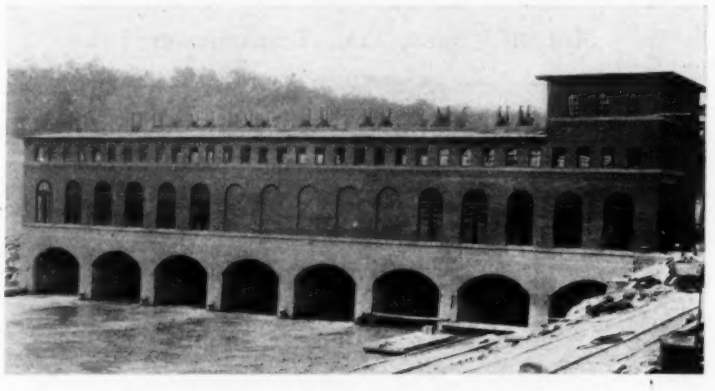


FIG. 5.—POWER STATION AND TAIL-RACE.

The next seven are generator panels, one for each generator. Each of these is mounted with a 600-amp., alternating ammeter, a 2,400-kw polyphase indicating wattmeter, one synchronizing receptacle, a field rheostat and two operating handles for working the oil circuit-breakers below the board. In addition to these instruments, there are a 300-amp. type direct-current ammeter and a plug receptacle to measure the field current; a 200-amp. field discharging switch and two voltmeter plug receptacles.

The next two are totalizing panels, each mounted with three 2,000-amp., alternating ammeters, a power factor meter, a polyphase integrating wattmeter, two operating handles controlling the automatic circuit-breakers, and an overload time-limit relay. On the left-hand swinging panel are placed three 30,000-volt voltmeters and a three-phase synchronoscope. On the right-hand swinging panel there are two frequency meters.

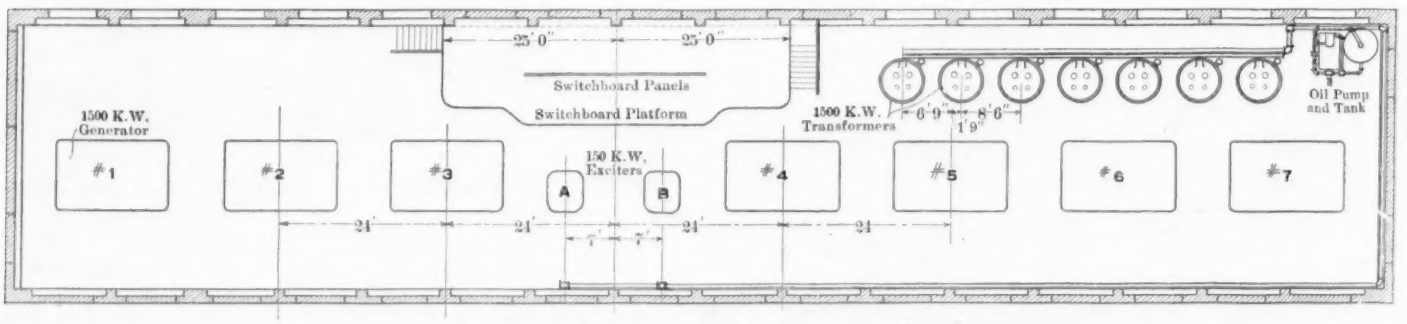


FIG. 4.—PLAN OF MAIN FLOOR OF POWER STATION.

The height of the board is 7 ft. 8 in. and its length over all, exclusive of swinging panels, is 24 ft. All the instruments are standard Westinghouse make, and this company also constructed the switchboard. The board is elevated 10 ft. above the floor of the station on a gallery and is reached by two stairways—one at either end. The plan of the station, shown in Fig. 4, indicates its location and the accompanying photographic view of the interior of the station shows its general appearance.

As a protection against lightning discharges, there is a "low-equiv-

alent" lightning arrester in each outgoing circuit. These arresters are made up of a combination of spark-gaps and two non-inductive resistances, one resistance being in series with the spark-gaps and the other being shunted around some of the spark-gaps. The metal parts of the spark-gaps being of non-arcing metal, the station current cannot flow over them after a discharge to ground. Series choke coils are included in the line from the transformers to the arresters.

All the ground wires, which are No. 00 copper, are bunched together and carried out of the station to a copper ground plate buried in charcoal and surrounded by moist earth. One of the ground wires is carried along over the penstocks, and each pen-

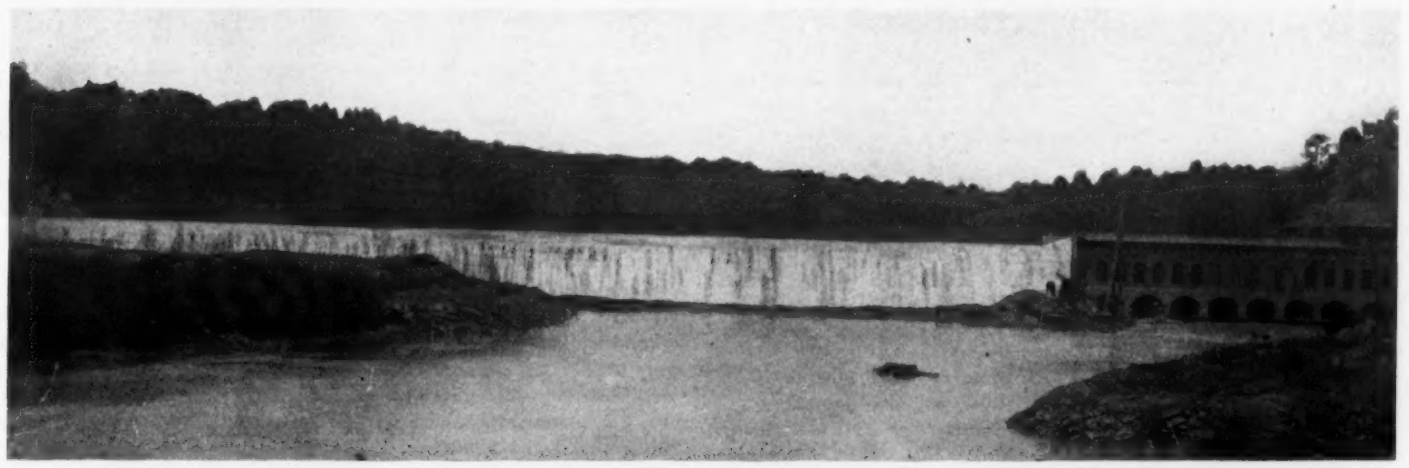


FIG. 6.—DAM AND POWER STATION.

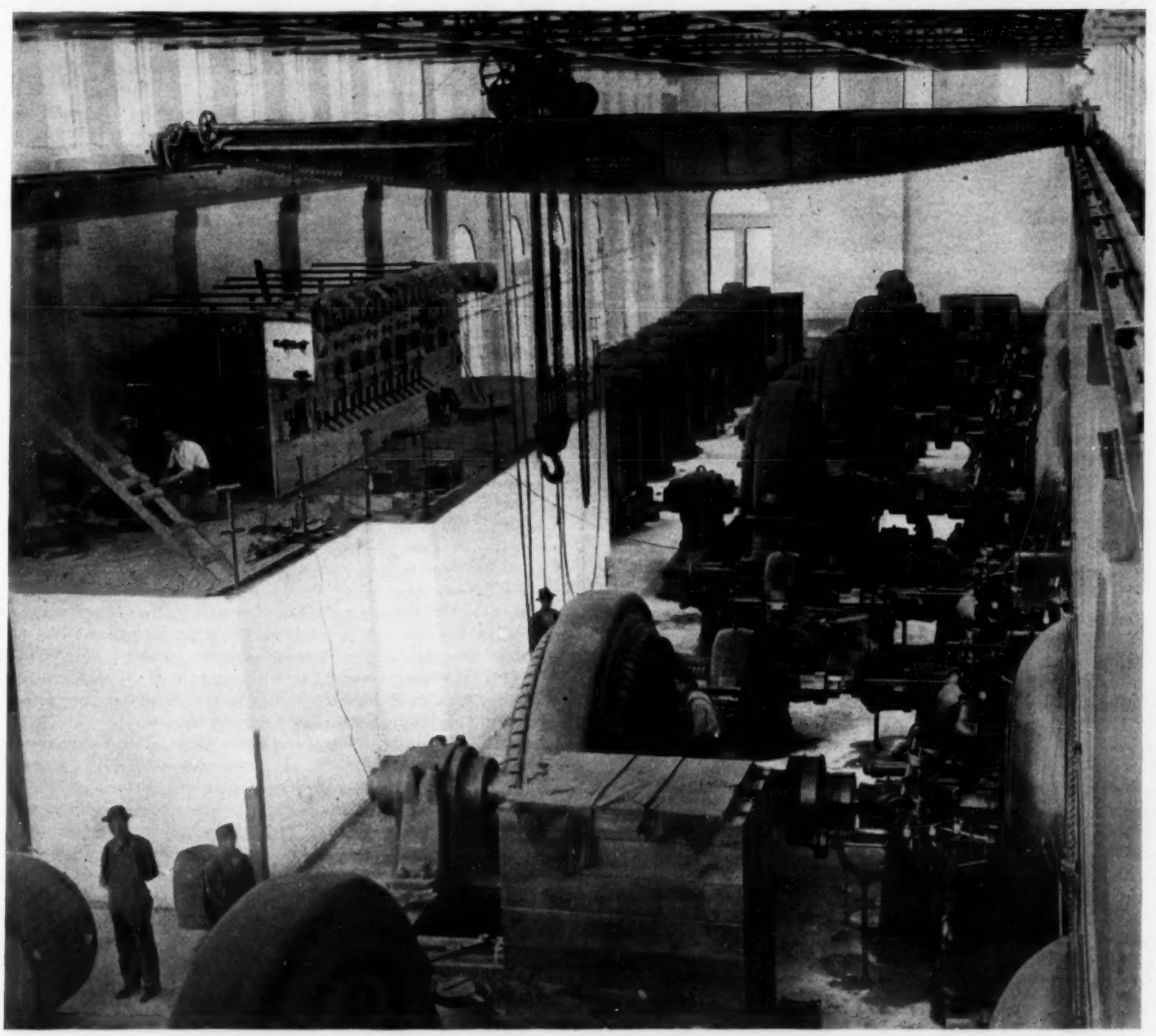


FIG. 7.—INTERIOR OF POWER STATION.

stock is connected to it by means of branch wires.

TRANSMISSION LINES.

There are two independent pole lines, each carrying one circuit. The pole and cross arms are exceptionally heavy and every precaution has been taken to insure the continuous delivery of current to the users. The poles are all white chestnut, about 30 ft. long and 8 in. or larger in diameter across the top. They are set 120 ft. apart, being first tarred at the butt up to 2 ft. above the ground line.

The cross arms are unusually large, being 4 x 6 in., of heart yellow pine, and are fastened to the poles by means of ¾-in. bolts, there being one bolt in each. They are braced to the pole by galvanized-iron braces, held in place by lag screws. The gains in the pole and the tops are coated with white lead. The cross arms are covered with two coats of red metallic paint. Double cross arms are used on all poles where the direction of the wires changes.

The insulators are of brown porcelain, triple-petticoat pattern, and are 8½ in. in diameter across the outer petticoat. Each insulator was tested at 80,000 volts before putting into position. They are designed to stand continuously a strain of 3,000 pounds, applied in the direction of the pull of the wires, and are of sufficient strength to strip the threads on a locust wood pin without breaking. The pins are of extra heavy locust wood treated with ozokerite.

The conductors are of No. 00 B. & S. hard-drawn copper. There are two circuits, one on each pole line. Each circuit is arranged in the form of an equilateral triangle, one being placed on top of

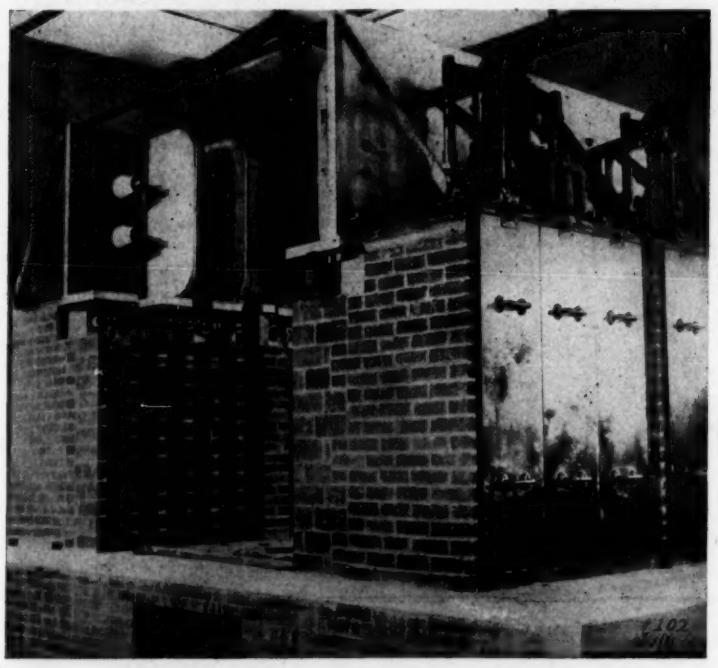


FIG. 8.—22,000-VOLT OIL CIRCUIT-BREAKERS.

the pole, and the other two on a cross arm below. The distance between wires is 36 in.

One line only will carry the entire Atlanta load without too great a drop for satisfactory service. The two are normally used in parallel, decreasing the losses and drop.

Where the lines leave the station they pass out through glass plates which fit into square openings in the tower. These plates are 24 in. on a side, by ¼ in. thick each, and have a 6-in. hole in the center through which a wire passes. Two plates are used in each opening, being set parallel at a distance apart of 12 in.

The transmission lines run parallel with each other, 40 ft. apart, and over private right of way most of the distance, there being occasional short stretches where they follow the public highway. The way is cleared on each side of the lines to a sufficient distance to prevent any falling trees from reaching and injuring the lines.

UNDERGROUND SYSTEM.

There is 1¼ miles of conduit made up of four lines of single-duct vitrified tile. The bore is square 3½ in. on a side.

Two of the ducts have conductors in them, each being No. 000 B. & S. paper-insulated cable, covered with an extra heavy lead sheath, and made by the National Conduit & Cable Company. Either cable will transmit the full-load current without excessive drop, or rise in temperature. Both are normally used in parallel, to reduce the line losses. The extra pair of ducts is for possible increase in the amount of copper that may become necessary.

The conduit is laid 3 ft. below the street surface, on a bedding of concrete, 4 in. thick, the other three sides being covered with a 3-in. layer of concrete. Manholes are placed every 400 ft. These are 4 x 8 ft. and 6 ft. deep on straight runs, and 6 x 6 x 6 ft. on corners, and are lined with concrete blocks, moulded into form and laid up in Portland cement. All are well drained and keep dry.

OPERATION.

Normally from one to five of the generators and six of the transformers are in service. All the units are worked in parallel, without any trouble or difficulty. The generators are synchronized by a synchronoscope which shows by the position of a needle when the machines are in step. No line troubles have developed in either the overhead or underground portions of the transmission line, and, with the care taken in their construction, there is no probability of interruption of service from any cause except malicious damage.

Westinghouse, Church, Kerr & Co. acted as engineers and auditors for the general design and supervision of the entire plant and were also the sub-contractors for the complete electrical equipment. The S. Morgan Smith Co., of York, Pa., was the general contractor for the complete power development. Messrs. John Bogart, George B. Francis, of New York, and William De la Barre, of Saint Paul, were consulting engineers on the hydraulic work. The dam and power house were constructed by Smith & Hardaway, of Baltimore, who were sub-contractors for the S. Morgan Smith Co. This portion of the work was supervised by Mr. William H. Cushman. The engineer and manager now in charge of the plant and equipment is Mr. F. W. Hadley, whose headquarters are at Morgan's Falls, Ga., with an executive office in Atlanta.

A Cross Town Subway for New York.

A franchise for the cross-town subway, connecting the tunnel of the New York & Jersey Railroad Company with the business section of the city, was formally granted at the meeting of the Board of Rapid Transit Commission last week. Under its terms the New York & Jersey Company agrees to construct a double-track road from its present terminal, at Greenwich and Christopher Streets, under Hudson Street to Sixth Avenue, the franchise for this portion of the road being granted in perpetuity, as it was required for terminal facilities alone, Controller Grout explained. From the junction with Sixth Avenue there will be a road built north under Sixth Avenue to Thirty-third Street and another branch extending under Ninth Street to Fourth Avenue, where it will connect with the present Subway. This will also be double-tracked, and will be extended east as far as Second Avenue if in the future it shall be decided that such extension is necessary.

It is provided that the franchise shall become void unless the New York & Jersey Company shall, within six months, secure the consent of the Aldermen and Mayor and within a year the consents of at least 50 per cent. of the abutting property owners. The New York & Jersey Company binds itself to begin work within six months after securing such consents and to have the subway completed and in operation within five years from the date of the signing of the contract between the company and the Rapid Transit Commission.

For the privilege the company will pay to the city a rental of 50 cents per linear foot of track and station platforms for a period of ten years and $1 per foot after that time and up to the expiration of the contract, as well as 4 per cent. on the estimated valuation of the vault space occupied in the operation of the road. For the first ten years of operation it will pay to the city $9,000 a year rental in lieu of a percentage on the receipts, and thereafter will pay a rental equivalent to 5 per cent. of the gross earnings of the road. This latter rental will be subject to readjustment at 25-year periods so long as the franchise exists. Both the Sixth Avenue and the Ninth Street lines may be purchased by the city at the end of 25 years of operation for the actual cost of construction.

It is provided that all stations shall be on private property to be acquired by the construction company, thus doing away with the kiosks. It is also provided that there shall be no opening of the streets at any part of the construction, and the constructing company assumes the payment of all claims for damages that may arise from abutting property owners.

Completion of the Janesville Transmission Plant.

The Janesville Electric Company has just issued an interesting pamphlet as to its system now in operation. As one enters the city of Janesville from the north or south along the elevated tracks of the Northwestern or St. Paul roads, he gets a strikingly beautiful view of the city, nestling in the valley of the rock. At night, approaching the same way, one is struck with the magnificent scene of the twinkling electric lights, which are stationed two or three blocks apart over almost the entire city. It is an electrical sign of the business prosperity and good condition of this thriving city. Few even of the residents of the city of Janesville appreciate the fact that there is located in the city an electric company which has a plant different from that found in any of the so-called prairie cities of this country. This difference lies in the fact that the power is furnished from three separate water powers. The Janesville Electric Company has just about completed what it calls its central power station. The company has at Fulton a power station, its dam there furnishing about a 14-ft. head. It has at Fulton three 75-hp water wheels and one 200-hp dynamo, which sends electrical energy to Janesville over a transmission line twelve miles long at a pressure of 6,600 volts. On the way to Janesville there is taken from this line the power to light and operate motors at the Rock County farm north of Janesville. There is also at Fulton one 80-hp dynamo used for lighting Edgerton.

The lower plant of the company is located at Monterey at the end of the raceway. The power there is from water under a head of about 9½ ft. At this point there are four water wheels, furnishing 350 hp. In addition to the water power the company has a duplicate steam plant, consisting of a 350-hp compound condensing engine, being the largest steam engine, and the only one of its kind in Janesville. Steam is supplied this engine when in use by three 100-hp boilers, and in this plant, operated by the water wheels all ready to be connected with the engine, is a 350-hp dynamo for furnishing electrical energy to the city. In the Monterey plant there is also a smaller dynamo which lights and furnishes power to the Wisconsin School for the blind, located in the southern part of the city.

The central plant of the company is located at the west end of the upper dam. This plant is just nearing completion, having been building for the past year and a half. The foundation, flume, walls and penstock are constructed of concrete with steel reinforcements. The water wheels are of the latest turbine type, known as the Samson model and built by the James Leffel Company, of Springfield, Ohio. They are six in number and will develop about 750 hp. The upper works and horizontal shafting, which takes the power from the water wheels, are very massive and were put in for durability and to stand heavy and continuous work. The machinery is so arranged that any wheel or wheels can be disconnected when not needed, or should there be occasion to make repairs. The building of the central plant is constructed of the hollow, concrete blocks made in Janesville and presents a very handsome appearance.

The roof of the central plant is supported by steel trusses, covered with asbestos roofing and contains ample ventilators and skylights. The main building is 55 x 80 ft., the boiler room 40 x 40 ft. and the wheel house 16 x 70 ft. The floor is of cement and every precaution has been taken to render the building as nearly fire-proof as possible. At this plant there is also, in addition to the water power, a duplicate steam plant, consisting of a 200-hp water-tube boiler of the very latest pattern. There is space in the boiler room for installing three more similar boilers should the business of the company increase and these additions be required. The smoke passes through a concrete smoke tunnel under the floor of the boiler room to the outside of the building before it enters the stack. The shaft from the wheel house passes across the dynamo room and is equipped with pulley so as to connect the various dynamos, motors and engines. The machinery is so arranged that any piece can be cut out and started again without disturbing in any way the operation of the others. The shafting is supported on massive concrete piers and runs in improved, self-oiling, adjustable bearings. The local street railway is at present operated from power furnished from two dynamos driven from the main shaft. As part of the steam plant there is a 300-hp Corliss condensing engine and a 150-hp, high-speed engine, particularly adapted to run the street railway generator, and which can be used on the general plant in case of emergency. Connected with the main shaft are also two large motors which take the power from the Fulton plant and from the Monterey plant. In addition to the dynamos actually in use, the company keeps one dynamo in reserve.

The distribution and control of the power is made through a line of massive marble and steel switchboards. There are four circuits of city arc lights at the present time and these circuits are controlled from four panels with the accompanying regulating apparatus, with machinery for sending out to the street lights of the city, which number 210. The company is furnishing light now to about 12,000 incandescent lamps and has upon its line about 200 motors.

The machinery and building were planned and their erection superintended by D. C. and W. B. Jackson, mechanical and electrical engineers of Madison, Wis. The buildings were designed so that future extensions could be provided for.

A Large Power Plant Scheme For New Zealand.

Special correspondence in the London newspapers discusses the important question of utilizing the waste water powers of New Zealand electrically. Within the past two or three years considerable attention has been devoted to the possibility of obtaining cheap electrical energy for traction and for manufacturing purposes within the colony. The four cities—Auckland, Wellington, Christchurch and Dunedin—have gone in for expensive systems of electric tramways. In each instance the current is generated by steam power; but in the case of Dunedin steps are now being taken to obtain electrical energy for this purpose, and also for manufacturing and lighting purposes, from a water power available in the vicinity that will reduce the cost to about one-fourth of what it is at present. In 1903 the Government engaged Mr. L. M. Hancock, M.A.I.E.E., a competent American expert, to report upon the New Zealand water powers with a view to determining their possibilities in regard to the supply of cheap electrical energy for manufacturing and other purposes. Mr. Hancock is the electrical engineer and general superintendent of the Transmission Department of the California Gas & Electric Corporation. He was selected for this purpose in view of his connection with the celebrated Bay Counties Power Company and his general qualifications as an electrical expert. His report has just been presented to Parliament, and, though it does not go greatly into detail, it shows clearly the wonderful potentialities that exist for the generation of electrical energy from water power in New Zealand.

After detailing the various water power systems inspected, Mr. Hancock declares that there is a wonderful supply for a country of the size of New Zealand. The fact that the North Island, of only 45,565 square miles, and the South Island, with only 59,054 square miles, contain such a wealth of power, he adds, speaks volumes for their future. The immense supply of power available will some day enable each home in the colony to enjoy luxuries that in other countries are enjoyed only by the rich. The manufacture of goods for all Australasia, and a great portion of the Far East, can be done there better and cheaper than anywhere else. Being so near these markets, with this unlimited power, and having a climate not surpassed, and scarcely equalled, anywhere, and suited to a degree to manufacturing purposes, the possibilities of the colony are declared to be almost beyond the bounds of fancy. Mr. Hancock points out that New Zealand can produce food and clothing of unequalled quality and quantity considering her area. He therefore urges the encouragement of manufactures, making concessions for a term of years to get them fairly started. Both islands, he adds, have great reserve resources that only await development to repay rich investments, and the wonderful development already reached is worthy of great praise.

Since Mr. Hancock's report was received a more detailed report on the same subject has been made by Mr. P. S. Hay, H.A., M.Inst. C.E., who is superintending engineer in the N. L. Public Works Department. This report is confirmatory of Mr. Hancock's estimate of the enormous amount of water power available in the colony. On the information available the estimated amount of hydraulic power in the North Island is 500,000 B.hp, and in the South Island 3,200,000 B.hp, a total for the colony of 3,700,000 B.hp continuous working, or about 30 times the amount of power now used for tractive and industrial purposes.

Some concluding remarks from Mr. Hay's report are interesting. He says: "The amount of effective power for motive power, light-

ing, etc., available after transmission may be put at 2,220,000 B.hp continuous working, or 4,440,000 B.hp for half-time full power. At the assumed rate of £12 for the horse-power year, the gross revenue would be £26,640,000 a year in each case if all the energy could be utilized. To supply electric power to take the place of all steam, gas and other plants, also locomotives now in use in the colony, would require an installation of, say, 420,000 B.hp to give 250,000 B.hp effective. The cost would be about £12,000,000, or perhaps less by selecting the easiest developed schemes. In addition there would be the cost of conversion of railways and existing steam plants, the cost of which would be great, also for distributing networks in towns, etc., together, perhaps, £5,000,000; but this is only tentative, as the questions all require a very lengthy study. It is, however, impossible to displace all steam and other prime-movers by electrically-transmitted power. The percentage of inconvertible plant cannot now be estimated. The cost of steam plant to give power equivalent to the 2,220,000 B.hp, or 4,440,000 B.hp taken above, to be available from the hydraulic schemes after transmission, would be approximately about half, or rather more than the cost of the hydraulic and electric plant, but the cost of working per brake horse-power would be much greater—about double on the average, and much more for small plants. The coal required to give power equivalent to the amount possible to deliver as given above would be 17,500,000 tons of the best quality of coal used in first-class large plants, and likely to be very much more if many small plants were employed, and still more if the inferior kinds of New Zealand coal were used. This amount of coal, in addition to what would be required for other purposes each year, would, in a comparatively short time, make an appreciable inroad on New Zealand's relatively slender stock of coal, a fixed quantity only, which cannot be renewed. On the other hand, the potentialities of water power will remain as a national asset as long as the climatic conditions and the mountains endure."

Meeting of the A. A. A. S.

The annual meeting of the American Association for the Advancement of Science and of the American Physical Society is being held in Philadelphia, Pa., during "Convocation Week," from December 26, 1904, to January 2, 1905. The presiding officers are Prof. W. F. Magie, the vice-president of Section B, and Prof. Arthur G. Webster, president of the American Physical Society. The opening session of Section B will be held on Wednesday after the adjournment of the General Session, about 11 o'clock a.m., at which time the section will organize, elect committees, and listen to the reading of papers. The reading of papers will be continued on Thursday. At 2.30 o'clock, on that day, the retiring vice-president, Prof. Edwin H. Hall, will give the vice-presidential address, on "A Tentative Theory of Thermo-electric Action. On Friday, December 30, the annual business meeting of the American Physical Society will be held, and on this day the programme will consist of papers by members of this society. If the number of papers is sufficient the session will continue through Saturday. All sessions will be held in the Morgan Laboratory of Physics, of the University of Pennsylvania, located on Thirty-fourth Street, between Walnut and Spruce Streets. Below are noted some of the papers to be read:

"Experimental Study of the Use of Weston Instruments for Ballistic Magnetic Testing," Alb. F. Ganz, Stevens Institute of Technology; "Explanation and Demonstration of the Poulsen Telegraphone," Z. B. Babbitt, New York City; "Electric Double Refraction in Liquids Under Low Electric Stresses, and also at the Boiling Point," D. B. Brace, G. W. Elmen and L. B. Morse, University of Nebraska; "The Electromagnetic Theory and the Velocity of Light," Henry T. Eddy, University of Minnesota; address by Edwin H. Hall, of Harvard University, the retiring vice-president of Section B, on "A Tentative Theory of Thermoelectric Action;" "The Distribution of Energy in the Visible Spectrum," Edward L. Nichols, Cornell University; "Objective Method for Showing Distribution of Nuclei Produced by X-Rays or Other Radiation," C. Barus, Brown University; "Experiments on Resonance in Wireless Telegraph Circuits," G. W. Pierce, Harvard University; "The Ratio of Electrical to Gravitational Forces," Bergen Davis, Columbia University; "A Measurement of the Thomson Thermo-electric Effect in Iron," Edwin H. Hall, Harvard University; "A Contribution to the Theory of Thermo-electromotive Force," C. B. Thwing, Syracuse University; "New Phenomena of Fluorescence," Harry W. Morse, Harvard University; "The Tuning of Thermo-electric Receivers for Electric Waves," A. D. Cole, Ohio State University; "The Capacity and Resistance of Aluminum Anode Films," C. McC. Gordon, Central University; "The Chemical Combination of Oxygen and Hydrogen Under the Action of Radium Rays," Bergen Davis and C. W. Edwards, Columbia University; "Note on the Use of Sensitive Quadrant Electrometers," J. C. McLennan, University of Toronto; "On the Decay of the Excited Radioactivity from Natural Causes," Miss L. B. Johnson; "On the Secondary Radiation Excited in Metals by the Gamma Rays from Radium," H. F. Dawes.

A special telegram from Philadelphia, of December 27, says: "More than 1,500 of the best-known scientists of the United States are in this city to attend the various meetings of the fifty-fourth convocation of the American Association for the Advancement of Science, which began here to-day and will continue until Friday. During the convocation forty scientific societies, subsidiary to the National organization, will hold meetings. All the sessions will be held in the buildings of the University of Pennsylvania. Carroll D. Wright will deliver his farewell address to-morrow night and will retire from the presidency of the association. He will be succeeded by Prof. W. G. Farlow, of Harvard. The newly elected vice-presidents, who are also the heads of various societies comprising the association, are Prof. Alexander Ziwet, University of Michigan; Prof. W. F. Magie, Princeton; Prof. L. P. Kinnicutt, Worcester Polytechnic Institute; Prof. D. S. Jacobus, Stevens Institute; Prof. Eugene A. Smith, University of Alabama; Prof. C. Hart Merriam, Department of Agriculture, Washington; Prof. B. L. Robinson, Harvard; Dr. Walter Hough, National Museum, Washington; M. A. Knapp, chairman of the Interstate Commerce Commission, and Prof. H. P. Bowditch, Harvard.

Municipal Lighting Plant Failures.

City Councilman Collister, of South Brooklyn, a suburb of Cleveland, says that the municipal lighting plant in his village is a failure. "Instead of saving the people $150 a month, as Mayor Johnson claims, it is a burden to the citizens and taxpayers of the village. When the municipal lighting plant was constructed we were told that we would save a great deal of money. But the first year it took just one-half of the total tax levy of the year to support the plant. The second year it took 3.5 mills out of ten mills to support the plant. This year 4.5 mills out of 10 were appropriated for the lighting plant. And yet about six weeks ago the mayor told me that the lighting plant was deep in debt. In fact, he thought that it was $2,000 in arrears. The wages of the employes of the lighting plant hadn't been paid for from two or three months and they were threatening to quit. He said to me: 'We'll have to have more money or we'll have to give up the plant.' He told the other councilman the same thing. The next week at council meeting we authorized a $5,000 loan for the lighting plant. When this was made the mayor said he didn't think that even that sum would be sufficient to pay the expenses of the plant until the money from the taxes was available. The municipal lighting plant has raised taxes a great deal and the people have become so discouraged that they want annexation to Cleveland in order to get rid of the expense of supporting the plant."

Councilman Brandisch stated that the lighting plant has doubled the taxes of the village.

Middleboro, Mass., seems to be in equally bad condition. A telegram from that city of December 13 to the Boston newspapers says: "The investigations made by the Business Men's Club into the condition of the municipal lighting plant, and the report of the special committee, made at its annual meeting, is opening up the whole question of street lighting and commercial lighting here as it has not been done before since the town went into the business of making light for its own use and for sale to the public. The estimates given show that if the town to-day abandoned gas making and electric lighting it would have cost the town nearly $150,000 for its outfit, together with the expense attached since it has begun to operate by the municipality.

"Men of good judgment think that it would be difficult to find a purchaser for the plant as it stands at $50,000, and it would require not less than $20,000, it is estimated, to place it on a basis to do effectual work in accordance with the demands of the day in street and commercial lighting. It has been a very costly plaything for Middleboro, and promises to become more so rather than less."

Maximum Distance to Which Power Can be Economically Transmitted.

At the December meeting on last Friday of the American Institute of Electrical Engineers, Mr. Ralph D. Mershon read his International Electrical Congress paper, which develops an equation for determining the maximum distance to which power can be economically transmitted. We give below a condensation of that portion of the paper which precedes the mathematical part.

The author, in the introduction, states that the method of treatment will, with suitable changes in the values of constants, apply so long as present methods of power transmission obtain, and makes possible a comprehensive view of the possibilities of long-distance transmission.

The elements which, in the broadest sense, limit the distance to which power can be economically transmitted, are the cost of power at the generating station, and the price which can be obtained for the delivered power. The difference between these two elements must cover the cost of transmission, the interest on the investment and the profit. The cost of transmission comprises the loss of power in transmission, the cost of operating and the cost of maintenance and repair. The value of the sum total of the interest which must be paid upon the investment, and the minimum profit which is considered satisfactory, will have much weight in determining the limiting distance of transmission. The less this sum is the farther power can be transmitted; a low interest rate and a low rate of dividend will, therefore, be conducive to long transmissions.

In a general way, the manner in which the investment in a transmission plant and the annual charges and expenses in connection with the plant vary with different outputs, voltages and distances of transmission, is as follows: For a given voltage, drop and distance of transmission, the cost of all the apparatus and equipment, except the line conductors, will increase more slowly than the output of the plant. That is, the greater the output of the plant the less the cost per kilowatt of all the equipment, except the line conductors. This will be true of the operating expenses also. Therefore, since the interest charges and the charges for depreciation and repair are dependent upon the investment, the greater the output of the plant the less will be the quantities going to make up the annual cost per kilowatt of transmitting power, except those depending upon the line conductors. Since the weight of the line conductors under the conditions assumed will vary directly as the amount of power transmitted, those elements of the annual cost per kilowatt depending upon the line conductors will be practically constant for all amounts of power transmitted and cannot be materially reduced by increasing the amount of power transmitted. With the same voltage, economic drop and output, the elements of annual cost per kilowatt due to the line structure (pole line) and to its extent (patrolling, etc.), will increase directly at the distance. But any increase of cost in line structure due to increase in distance can be offset by increase of output. On the other hand, the weight of the line conductors increases as the distance (for the same *economic* drop) and the elements of annual cost per kilowatt due to the weight of the line conductors will, therefore, increase as the distance, no matter what the output.

It appears, therefore, that all the elements in the annual cost per kilowatt for transmitting power, except those dependent upon the line conductors, may be continually reduced by increasing the amount of power to be transmitted. The annual cost per kilowatt due to the line conductors cannot be so reduced. It can be diminished only by such other means as will reduce the first cost of the conductors. As the first cost of the line conductors can be reduced only by increasing the voltage of transmission and as there is a limit to which such increase can be carried, it follows that *the limiting distance to which power can be economically transmitted will depend, finally, upon the cost of the line conductors and upon this alone.*

The limit of voltage referred to is not necessarily that due to physical considerations, such as difficulties of construction, air losses between conductors, etc.; for, leaving such matters out of consideration, it is easy to imagine the voltage carried to such a high value as will reduce the line conductors to the point when the increased cost of transformers and insulators, due to a further increase of voltage, will overbalance the saving in the line conductors, due to such further increase.

To simplify the treatment of the subject, it is assumed that in the cost of transmission is included the interest on the investment (bond interest) and that over and above this cost there must be earned a certain percentage, which percentage will represent profits (stock dividends). In addition the following assumptions are made:

Power purchased at low-tension bus-bars of step-up transformers and sold at outgoing bus-bars of the step-down station.

Frequency of transmission not less than 25 cycles nor more than 30 cycles as being the limiting frequencies which, while favorable to the transmission of power, are yet suitable for almost all purposes to which power can be applied.

Idle synchronous motors at step-down station to correct for power factor, the average power factor of the line being held as near unity as possible. In the plants of large output dealt with, the possible approximation to unity power factor will, in spite of the line-charging current, be sufficiently close, for practical purposes, to justify the assumption of unity power factor.

No matter what the capacity of the plant, there will be three transmission lines, each capable of carrying one-third the load; the power factor of the load supplied will be 0.8; the number of transforming units at each end of the line be 18, each transformer being normally worked at 5/6 of its rated capacity, so that one bank of three may be cut out, if need be; the number of connective synchronous motors will be six, each being worked at 5/6 of its rater capacity. The kilowatt-ampere capacity of these synchronous motors must, for a load power factor of 0.8, be equal to 3/4 of the kilowatt capacity of the load carried by the plant.

It is evident that the number of units must be considered as the same for plants of all capacities in order to take full advantage of the decrease of cost per kilowatt, due to increase of capacity.

The pole lines are assumed as constructed with 12 steel towers to the mile.

Ideal conditions are assumed throughout consistent with delivering reliable and cheap power. Since the object is to determine the *maximum* distance, the factors fixing commercial costs of apparatus are taken at the lowest values likely to obtain.

Later on in the paper general equations are derived expressing the relations between the distance of transmission and the quantities which govern it. By making assumptions, in addition to those mentioned above, as to the values of the various coefficients in the general equations, and as to the purchase and selling price of the power, several curves were laid down. In obtaining these curves the constants were given values favorable to long transmission distances. The costs were taken lower than those ordinarily current in the endeavor to anticipate somewhat possible future prices. Also, the cost of power purchased at the step-up station was fixed at the low figure of $10.90 per kilowatt per annum. The diameters of conductors in the curves and the voltages to which they correspond were compared with the values of diameter and critical voltage given by Prof. Harris J. Ryan in his recent Institute paper on that subject, and the diameters from the curves were found to be considerably above those of the paper. The values are affected by the price paid for power at the step-up transformers, but if this be taken even as high as $20 per kilowatt per annum instead of $10.90, the diameters of the conductors remain below those for the critical voltages. It appears, therefore, in the light of present knowledge that the limit of voltage will come through economic conditions and not through conditions depending upon atmospheric losses.

Power prices are so dependent upon conditions, especially those arising from the location and magnitude of the market and of the supply, that any figure chosen will be objected to by some as too high and by others as too low. The same condition applies to the price assumed as that paid for power at the step-up station, but in a lesser degree. The figure assumed as the price of the power sold, $34 per kilowatt per annum, is one which seems to be fairly representative, especially in the case of the large blocks of power. The values taken have been chosen as being as nearly representative as possible of the best conditions which might obtain, favorable to long-distance transmission.

The voltages involved are much higher than those now in use commercially, but they are not beyond the range of future possibility. Manufacturers will now undertake commercial transformers for voltages as high as 150,000 volts, and there is little question that when the demand shall come for units of the large capacities contemplated herein, the voltage requirements will be met. Such transformers will be structures of sufficient size to permit of being gotten at and worked upon from the inside as well as the outside and this, in connection with the fact that more space may be utilized for in-

sulation, will render construction for high voltages much less difficult than at present.

The maximum amount of power dealt with, 500,000 kw, is probably too high to be seriously considered at this time, but from 200,000 to 300,000 kw is believed to be within the range of immediate future possibility. In a plant of this size it is probable that a net return of 12 per cent. would be required, not alone for the purpose of dividends, but also as a protection to the bonds.

Under these conditions the curves show the distance of transmission to vary from 512 miles for 200,000 kw to 623 miles for 300,000 kw. For the present outlook, therefore, the limiting distance of transmission will, for some time at least, be in the neighborhood of 550 miles. It also appears that voltage limits will be fixed not by conditions depending upon atmospheric losses, but by economic conditions. The latter conclusion is, perhaps, of greater present importance than the subject forming the title of the paper.

The discussion of the paper was participated in by President Lieb and Messrs. H. G. Stott, Philip Torchio, J. F. Wallace, C. H. Parmly, M. H. Gerry, Jr., A. E. Kennelly, Charles F. Scott, C. L. de Muralt and P. G. Gossler. Mr. Stott pointed out that the transmission of power from Niagara Falls to New York comes well within the limits defined by Mr. Mershon. He did not approve of any formula dealing with the question that does not take into consideration the load factor, and did not believe that power from any steam plant would cost as much as $34 per kilowatt, and that very few water power plants could sell power at $10.90. He thought that there is a wide scope for discussion as to whether a frequency of 25 cycles is not too low, particularly since in the West 60 cycles are used almost exclusively, which higher frequency assists to compensate for a large lag.

Mr. Torchio referred to the mistaken interpretation often given to the Kelvin law for the determination of the cross-section of conductors. Requirements as to the safe carrying capacity of wires, the regulation, brush discharges of high-tension lines, etc., may substantially modify the conclusions arrived at through the use of the law. He criticised the assumption of $10.90 per kw per annum for line losses, to which is contrasted the assumption in the paper that the greater the output of a plant the less is the cost per kilowatt of all the equipment; the capacity of plant to provide for less can certainly be increased for considerably less than the average cost of the entire plant. He did not agree that the cost of power will materially increase, for it will be fixed for centuries to come by the cost of power derived from coal. At present the total coal consumption in this country is exactly 1,000,000 tons per day, while that used in electrical generation is less than 2,000,000 tons per annum. While the cost of coal will probably increase, it is also quite probable that the efficiency of the heat engine will also be increased. He estimates that the total cost of generating equipment for a capacity of 2,075,000 kw, which is that now installed in this country, would amount to $207,500,000, involving an annual charge of $25,937,500, which added to the cost of the fuel would make the total $47,137,500, to be compared with the $70,550,000 cost of water power. The assumption of $34 per kw per annum is consequently excessive, and on the basis of the operation of all electric light and railway stations of the United States for the year ending June 30, 1902, the price should have been reduced to $22.72. He believed that if water power is ever transmitted to large markets like New York it will be necessary to keep at these centers a reserve steam generating capacity, first for tiding over shutdowns of the transmission power and second for taking care of the peak load.

Mr. Wallace pointed out that one of the important conclusions of Mr. Mershon was based upon a curve, the significant part of which is quite flat, and that if this curve were corrected for the increased cost of insulators at high voltage and increased cost of transformers, a much lower economic voltage would result than that accepted by the author. Moreover, at lower voltages there is increased reliability of operation, which again modifies the conclusion to be drawn from the curve. He believed that any decision regarding transmission potentials should take into consideration greater reliability of operation at lower voltages, and that good engineering would soon create a condition whereby the line cost would increase directly with the output, owing to the use of multiple lines. Mr. Wallace also criticised the manner in which the author of the paper made the factor of total investment enter into the equations, which affected the correctness of the formula given for profitable efficiency. Load factor, he said, on both line and generating stations also affects profitable efficiency, though neglected by the author. He considered that the figure of $62.50, which is deduced as the cost of the generating plant per kilowatt, is entirely too low and that the cost of the hydraulic development alone would exceed $90 per kw. He also said that an error was made in the application of Kelvin's law to the case.

Mr. Parmly criticised one of the equations, which he said was improperly solved for the reason that it was treated as an equation of one variable, whereas it contained three variables. Mr. Gerry said that he had always considered mathematical analysis of a question of the kind treated in the paper as a doubtful utility, not because the analysis itself may not be correct, but because of the fact that there are so many things entering into it that require assumptions involving engineering judgment on matters yet in the future, that the results may be nothing more than curiosities so far as practical purposes are concerned. By modifying the assumptions of the paper, it would be easy to show that the economic distance of transmission is limited either to 200 miles or 2,000 miles, and consequently analyses of the kind are merely an example of mathematical gymnastics. He considered that there is nothing before us that would justify the assumption of limitation of 500 miles or 2,000 miles, and he believed it a mistake to bring before the Institute results from the mathematical development as given in the various curves, since they may mislead persons not familiar with the subject and may even mislead engineers.

Dr. Kennelly said that he thought it only fair to the author to recognize that the paper is merely a statement of possibilities under assumptions clearly outlined and that it did not pretend to serve as a standard for commercial practices of the present day; the voltages dealt with go as high as 170,000 volts, while the highest voltage now used is something like 60,000 volts. The paper is interesting in so far as it goes in showing that under the conditions assumed, which are certainly not the conditions of to-day, and perhaps are conditions never to be realized, it would be possible to buy power at $10.90 and sell it at $34 at a distance of 500 miles. Mr. C. P. Scott, in referring to the work of Mr. Mershon in experimenting some years ago in the West on the limits of high voltages in transmission, said that he himself, in making the experiments the subject of an Institute paper, had presented the conclusion that 60,000 volts was the upper limit. He said that he has been sorry for this statement ever since, for later developments had shown that the diameter of transmission wire was a factor, a larger diameter than that used in the experiments increasing the value of the critical voltage. The sizes of wire with the great quantities of energy with which the paper dealt, becomes so great that the limiting voltage no longer determines the maximum voltage of transmission. Mr. de Muralt thought that the selling price used by Mr. Mershon was entirely too high. In Switzerland, the ordinary price at which power is sold is about $22 per hp per year, or $30 per kw per year, notwithstanding that coal there is worth from $6 to $8 per ton; with cheap coal, as in this country, he believes that there would be great difficulty, no matter how large the amount of power and no matter how long the transmission distance, to sell any considerable amount of power at $34 per year. Mr. Gossler having criticised the statement of Mr. Torchio as to the cost of power, the latter said that the low figure which he gave is the cost of production with interest and depreciation of machinery, and is exclusive of real estate and buildings; that the selling expenses of a company which retails the power must be included, and a number of other items such as depreciation, interest and taxes on real estate and distributing lines, cost of distribution and general expenses.

Mr. Mershon, in closing the discussion, said that in his paper he had done in a general way just what an engineer does when he estimates on a specific plant. By means of formulas and comparatively few values he obtained a curve which will give some idea as to the extension of distance, of the various outputs and other quantities which economy would indicate should be followed. He did not consider that in the problem the load factor need be considered or any charge except the flat rate. All that was necessary was to divide the income by the peak, which gives a certain flat rate. In the steam plant fuel is a variable factor, but in the water power plant it cost practically the same per kilowatt, whether the whole or only a fraction of the output is delivered. He considered that while the cost of the generating plant was low, it was not as low as it might in some cases be. In view of the fact that the load is generally bunched up at the end of the line, a low frequency is undoubtedly advisable, a higher frequency only being beneficial when

the load is distributing along the line. As to prices of power in Switzerland, while on this side material is cheap and labor dear, on the other side labor is cheap and material dear. Concerning the criticisms of Mr. Wallace and Mr. Parmly, he said that it seems to apply to the Kelvin law.

Lodge Dislodging Fog.

All England was paralyzed last week by an unusually severe and prolonged fog, the descriptions of which are very interesting. In London the continued use of horse busses instead of modern trolley cars on tracks led to fearful confusion and congestion of traffic, and many of the busses even when the drivers led the horses by hand got stalled in the wrong streets in the darkness. There was great use of gas and electricity, but it did not seem to make much impression on the gloom. For electrical engineers one of the most interesting episodes is embodied in the following dispatch:

"There was one man who was profoundly grateful for the fog. That was Sir Oliver Lodge, to whom the dark visitation presented fresh opportunity to renew his campaign which he began twenty years ago against the fog. Standing in the secluded courtyard of Birmingham University, his deer stalker cap and long brown overcoat beaded with moisture, Sir Oliver was to be seen absorbed in contemplation of mysterious strands of barbed wire, which vanished a few feet above in impenetrable vapors. From his research laboratory came the vicious crackle of a powerful electric discharge, and great jagged sparks vibrated between the spherical terminals of the apparatus with which his assistants were preparing to launch the tentative thunderbolts of science against the British climate. Men pulled the terminals apart, and as the discharge was transferred to outside wires there proceeded from hundreds of invisible barbs overhead a fizzling noise like the sound of rain drops on hot plate.

"Then a wonderful thing happened. Through the opaque fog bank the outlines of the tall university buildings were gradually developed with the slow certainty of a photographic plate. The fog became a cloud, the cloud became merely mist, depositing itself in dank drops about the walls, writhing and squirming as though racked by the violence of the discharge. Away up in the eaves, 80 ft. high, could be seen elaborate insulators in which the barbed wires terminated. King Fog was conquered and put to flight. Then the current was shut off, the noise ceased and at once the fog rushed back and enveloped the courtyard once more. When it was suggested that a few of such installations would relieve any fog-bound city, Sir Oliver said: 'All I can do is to erect this model apparatus for the benefit of engineers who are interested in the subject.'

"Sir Oliver, in a published letter, adds: 'An electrical method of dissipation is not the right remedy for this artificially intensified evil, though it is a hopeful and proper method of attacking a natural mist in places where it interferes with navigation or commerce. But, although it is not the right remedy, any more than free meals and free doles are a sound remedy for the problem of poverty; yet, like them, it may have to be used as a temporary palliative in times of stress and while better methods are incubating. The cost of applying such a method to a whole city is probably prohibitory, but there are important centers where any means of mitigating the nuisance would seem to be legitimate."

Federal Franchise Control of Corporations.

Commissioner James R. Garfield, of the Bureau of Corporations, in his first annual report, has outlined a broad and striking scheme of Federal control of all corporations doing an interstate business. It contrasts the corporation law of Massachusetts wit hthe "piratical possibilities" of other States, and it declares that "a majority" of the corporations organized of late years have been organized for the stock market. The principal features of the Federal franchise system recommended by Mr. Garfield are as follows:

(*a*) The granting of a Federal franchise or license to engage in interstate commerce.

(*b*) The imposition of all necessary requirements as to corporate organization and management as a condition precedent to the grant of such franchise or license.

(*c*) The requirement of such reports and returns as may be desired as a condition of the retention of such franchise or license.

(*d*. The prohibition of all corporations and corporate agencies from engaging in interstate and foreign commerce without such Federal franchise or license.

(*e*) The full protection of the grantees of such franchise or license who obey the laws applicable thereto.

(*f*) The right to refuse or withdraw such franchise or license in case of violation of law, with appropriate right of judicial appeal to prevent abuse of power by the administrative officer.

"This bureau, under the direction of the Secretary of Commerce and Labor, affords the appropriate machinery for the administration of such a law," says Mr. Garfield. "It is fully appreciated that this recommendation is not new, but has been the subject of most serious and exhaustive consideration by public officials and commissions as well as private persons technically well qualified to speak."

Mr. Garfield's proposals are now the subject of considerable discussion and controversy in the newspapers and other public journals, and bid fair to furnish a topic of editorial comment and daily conversation for many months to come. Hearings on the subject by a Congressional committee are expected, and possibly some action may be taken in the way of introducing a bill on the subject.

Lectures at the Brooklyn Polytechnic.

On December 20 Prof. W. S. Barstow gave his second lecture in the course on central station practice at Brooklyn Polytechnic Institute. The subject treated was the arrangement and installation of equipment for central stations. The speaker began by taking up the question of the proper shape of the property selected and various methods for testing foundations, such as by boring with pipes, which method also serves to locate the wells. He then explained the necessity of selecting a datum line, especially where a station is to be located along a waterway, and also took up the blocking out of the station with regard to boilers, engines and their auxiliaries; the arrangement of piping; means for bringing heavy machinery castings into the station and for making repairs quickly, as well as the conveying of coal and the disposal of ashes. An interesting feature of the lecture was the discussion of probable load factors when determining the most suitable sizes of generating units.

The following questions were assigned to the students by Prof. Barstow:

1. Find the electrical center of distribution in Jersey City at the present time. 2. Safe limits of weighting per square foot for different soils, including piling. 3. The merits and demerits of different types of central station building construction. 4. Methods of floor and roof construction in central station buildings.

The following evening Prof. Charles F. Scott opened the course in Commercial Electrical Engineering by giving a lecture on the training and qualifications of the commercial electrical engineer. He spoke of the rapid progress made in the electrical engineering industry during the last twenty years and the need of well-trained technical graduates to fill the heavy demand caused by its rapid growth. The lecture in general was devoted to pointing out to the graduates of technical schools the great difference between the work they do in school and what is expected of them in commercial practice. As an illustration, Prof. Scott took up the organization of a large electrical manufacturing company and showed into how many divisions the work is divided and what a small number of the men employed is engaged in what might be called pure engineering work, such as the design of machinery. Prof. Scott's idea was to make clear the fact that the technical graduate does not necessarily become a designing engineer, but that there are many other departments of electrical activity where his training will prove advantageous, such as the installation and sale of electrical machinery. Prof. Scott assigned the following work.

1. The individual as a machine for doing work, the engineering principles involved and a study of the methods of securing the best output at the best efficiency.

2. Engineering progress statistics and other data, showing development of engineering education, engineering status, electrical manufactures, railways, power development, electric lighting, telephony and electrochemistry.

3. Principles vs. facts: Their relative importance in school training.

4. Methods of developing facility in the use of the English language.

5. Books and their use. Card indexes.

Carnegie and the Franklin Fund.

At a meeting of the Benjamin Franklin fund managers in Boston last week a letter was read from President Henry S. Pritchett, of the Massachusetts Institute of Technology containing a proposition from Andrew Carnegie to duplicate the amount of the fund, which has now reached $400,000, provided the total be devoted to the establishment of a school for the industrial training of men and women along the lines of the Mechanics and Tradesmen's School, of New York, and the Cooper Union, the city of Boston to furnish a site.

The board voted to thank Mr. Carnegie for his offer and to give the matter early consideration. A committee was appointed to study the question. In his letter to President Pritchett, Mr. Carnegie said: "I am a trustee of both the schools mentioned, and do not hesitate to say that to the best of my knowledge no money has produced more valuable results. I think it is from the class who not only spend laborious days, but who also spend laborious nights fitting themselves for hard work, that the most valuable citizens are to come. We are here helping only those who show intense desire and strong determination to help themselves—the only class worth helping; the only class that it is possible to help to any great extent."

CURRENT NEWS AND NOTES.

CONVENTION OF NORTHWESTERN ELECTRICAL ASSOCIATION.—The next convention of the Northwestern Electrical Association will be held in Milwaukee January 18, 19 and 20, 1905. President T. F. Grover states that it would be to the interest of street railway companies of the Northwest to become members of this association. Mr. T. R. Mercein, of Milwaukee, is secretary of the association.

DRAINAGE CANAL POWER AT JOLIET.—A handsome booklet entitled "Joliet," which the Citizens' Alliance of that city has recently issued, calls attention among other things to the great amount of cheap water power to be available soon at that place on account of the plans being carried out to utilize the fall of the water issuing from the Chicago Drainage Canal. About 10,000 gross hp is now being used in Joliet and plants are under construction both above and below the city which will aggregate 55,000 hp more.

ROOM FOR WIRELESS.—The severe wind storm that passed over New York State November 13 played havoc with the telegraph wires to such an extent that messages from New York City to Utica, Syracuse and Rochester had to go via Winnipeg, Canada. The route was from New York to Springfield, to Portland, to Canso, to Montreal, to Winnipeg, to St. Paul, to Chicago, to Cleveland, to Buffalo, and then to the isolated cities. The messages had to be sent a distance of several thousand miles to reach cities only three hundred miles away.

BOSTON HARBOR TUNNEL.—The new tunnel which has been constructed under Boston Harbor from the mainland to East Boston by the City of Boston was leased on December 24 to the Boston Elevated Railroad Company for a term of twenty-five years, dating from 1897, when the act for the tunnel's construction was passed by the Legislature. In consideration of the tunnel the railway company is to pay an annual rental to the city of an amount equal to three-eighths of 1 per cent. of the gross receipts each year of all its lines. In addition to this the railway company is to collect from each person passing through the tunnel a toll of 1 cent, which is to revert to the city. The East Boston tunnel, which is about a mile long, was built at an expense of over $3,000,000. It is now ready for use and will be opened to the public on December 30.

THE METER IN WAVE LENGTHS OF LIGHT.—In his presidential address before the recent general meeting of the American Society of Mechanical Engineers, Mr. Ambrose Swasey described an interesting application of the Michelson inferometer to determine the length of the meter in wave lengths of light. The determination was made by Prof. Michelson at the Bureau of Weights and Measures, at Sèvres, France, where the standard meter is kept in an underground vault and inspected only at long intervals. The work occupied nearly a year and the final result of the experiments shows that there are 1,553,164.5 wave lengths of red cadmium light in the French standard meter, at 15° C. So great is the accuracy of these experiments that they can be repeated within one part in 2,000,000. Should the material standard of length be damaged or destroyed, the standard wave length of light will remain unaltered, as a basis from which an exact duplicate of the original standard can be made.

THE ELECTRICAL FIRE HAZARD.—Mr. C. J. H. Woodbury, in discussing the electrical fire hazard recently before the Brooklyn Institute of Arts and Sciences, said: "The Associated Factory Mutual Insurance Companies of New England were pioneers in the application of technical work to the reduction of the fire loss, a task whose beneficent results have extended beyond the mills which form the specialty of this combination. The underwriters assume a great task in undertaking to maintain inspection over properties as widely extended and as numerous in detail as that of the commercial applications of electricity. The results show beyond peradventure that the electrical fire hazard is less than that of other methods of lighting and power transmission, while every telephone, being a fire alarm, the signaling systems are potent elements in the reduction of the fire loss. While the diminution of the ratio of such fire losses appears to be due to this work as the variable element in the problem, the question naturally arises, will the future permit its continuation to an extent which will be equal to the greater task of meeting the problems of depreciation of plant, and the congestion of the future to which the present applications of electricity are a mere preface. If the work remains in hands which can exercise the responsibilities to a uniform jurisdiction, then it will be sustained by the dominance of an approving public sentiment."

MR. JOHN W. LIEB, JR., president of the American Institute of Electrical Engineers, and past president of the New York Electrical Society, has just been the recipient of a high compliment in the form of a decoration, the King of Italy having made him a Commendatore of the Order of the Crown of Italy. This honor, paid to the profession in America, is also one that Mr. Lieb has deservedly won. He was a pioneer of electric light and traction in Italy when sent over there a score of years ago to introduce the Edison system, and founded the great company at Milan still in vigorous and prosperous existence. Since his return to the United States he has maintained intimate social and professional relationships with the kingdom. During the past summer, as chairman of the Institute Reception Committee, and member of the local committee of the Italian Electrical Association, he was unsparing in time, attention and effort, and to his work was very largely due the brilliant success of the entertainment, particularly in New York, where as one of the chief executives of the New York Edison Company, he was able to command also the resources of that progressive and public-spirited corporation. Knight Commander Lieb is to be heartily congratulated on this timely recognition, which is but another evidence of King Victor's cordial and intelligent appreciation of modern engineering science.

N. E. L. A. QUESTION BOX.—Mr. Homer E. Niesz, editor of the *Question Box* for the Denver-Colorado Springs meeting of the National Electric Light Association, has sent out over 7,000 letters to companies and individuals in the electrical field asking them to submit questions to be grouped under the following headings: A, Buildings; B, Water Wheels, Water Power, etc.; C, Feed Water, Heaters and Pumps; D, Fuel; E, Boilers and Mechanical Stokers; F, Forced Draft, Blowers, Stacks; G, Piping, Condensers, etc.; H, Engines; I, Turbines; J, District Heating; K, Generators and Exciters; L, Storage Batteries and Boosters; M, Switchboards, Instruments and Station Wiring; N, Belts and Shafting; O, Oil and Waste; P, Overhead Lines; Q, Underground Lines; R, Transformers; S, Lamps—Arc, Incandescent, etc.; T, Heating, Battery Charging and Power; U, Meters; V, Advertising; W, Contracts and Rates; X, Accounting and Statistics; Y, Management; Z, Miscellaneous. Mr. Niesz not only desires questions from those seeking information, but he appeals to the missionary spirit in those who have solved difficulties for themselves, and asks them to send questions to which they have found solutions, together with the replies, for the benefit of others. There is practically no limit to the benefits to be gained through this interchange of knowledge, and, if it were understood as it should be by central station companies not already members of the National Electric Light Association they would lose no time in taking membership.

X-RAY IN PEARL FISHING.—It is said that the use of X-rays has proved a valuable adjunct to pearl fishing in Ceylon. Formerly the beds were rapidly depleted by the destruction of oysters void of pearls or containing them in an immature state. By the application of the X-rays it is possible to discriminate, and oysters useless for commercial purposes are thrown back into the sea.

WIRELESS OVER ALPS.—A cable dispatch from Paris of December 17 says: "The first Marconi wireless telegram just sent over the Alps from Cornwall to Italy arrived without a mistake in the wording, despite fears that the rarefied atmosphere of the higher Alps would affect the message. The satisfactory settlement of this point is a definite scientific advance. The message was first received at Lausanne and then at a station on top of Monte Rosa, whence it went direct to Ancona."

SWAN KNIGHTED.—King Edward has conferred the honor of knighthood on Mr. Joseph W. Swan, inventor of the incandescent lamp bearing his name, and an inventor in other fields as well. He was born at Sunderland in 1828 and in 1881 started the first incandescent lamp manufacturing company in Europe. He was president of the Institution of Electrical Engineers in 1898-9 and is a Fellow of the Royal Society, an M.A. and D.Sc. of Durham University and a Knight of the Legion of Honor of France.

SENTENCED FOR SUBWAY ACCIDENT.—The Criminal Court of the Seine at Paris has convicted the four trainmen who were responsible for the catastrophe on the Metropolitan Electric Underground Railroad in August, 1903, resulting in the loss of 65 lives. Jouffroy, the conductor of the train, was sentenced to a month in prison and a $400 fine. Renaud, superintendent of the station, whose lack of calmness precipitated the panic, was sentenced to a month's imprisonment and $400 fine. Chauvin and Cavayle, motormen, were released with fines of $600 and $400, respectively, as they suffered permanent injuries.

WIRELESS IN NAVY.—It is stated from Washington that at the annual manœuvres in the Caribbean Sea, beginning in January and ending late in the spring, extensive experiments will be made with wireless telegraphy from vessel to vessel. Throughout the three months' work in all kinds of weather the trials will be made, and many of the orders will be transmitted by the wireless system. The Bureau of Equipment of the Navy Department has, as already stated in these columns, closed a contract for the installation of a Fessenden system on the *Alabama.* It is guaranteed to operate with the *Illinois,* which is equipped with the same system, at a distance of 250 miles with no conflict with other systems, and in bad weather.

THAWING WATER PIPES.—The National Electric Light Association, continuing its useful work of issuing to its members special reports and bulletins on topics of interest, has just put in circulation a very interesting report by Mr. George S. Haley, on "Electrical Methods of Thawing Water Pipes." As reporter for the association, this gentleman has made a very complete review of the situation, and as a citizen of Rutland, Vt., he may be safely assumed to have had abundant opportunities for testing the accuracy of all the statements in this document. The pamphlet runs a length of over 30 octavo pages, is well illustrated, and contains besides the descriptive tests tables giving the results of work done in different places. A number of questions were asked of central station companies by Mr. Haley, and he gives a digest of the answers. He reports that at least 75 electric light and power companies, to his knowledge, have employed the electric method of thawing pipes, and it appears that in almost every case the results were most satisfactory. Now that special apparatus is on the market for the easy accomplishment of this purpose, there is no good reason why every company north of the frost line should not annex to its own balance sheet at least part of the fabulous profits hitherto supposed to go into the pocket of the plumber, while conferring an inestimable benefit upon the community.

RATES FOR SERVICE.—Following up its useful work of last year, the National Electric Light Association has just issued for 1904 its rates for commercial lighting and power service. This information was collected by the McGraw Publishing Company in connection with data for the *Central Station List,* for the convenience of the companies to whom the joint inquiries were addressed; and then the answers were turned over to the association for editing and compilation. The present quarto pamphlet contains a great deal more information than did the one of last year, and the survey that is given of practice as to rates for different classes of service, rebates, discounts, lamp renewals and other features, is not only interesting but extremely valuable. The members of the association must necessarily find such information of use to them in station management and are to be congratulated upon the energy and intelligence with which this work is conducted by the organization. It is evident that a great deal of time and effort has been spent in making the work full and complete, and the omissions and inaccuracies, so far as one can determine, are so trivial as to reflect by their very insignificance great credit on the care exercised in the preparation of the bulletin. A piece of work of this nature is difficult to carry out and the association has done for its members what no member could do for himself.

STREET SIGNS.—Mr. Ahearn, president of Manhattan Borough, New York City, states that if the Board of Estimate and Apportionment will give him $30,000 he will put a name sign on every street corner in Manhattan. It is time something was done. The surveyors of his office have calculated that there are about 3,000 unmarked street corners. Two signs will be needed for each corner, and an average price of $5 a sign will use up the $30,000. If the plans under consideration are approved there will be three different forms of sign. One will hang box-shaped under the hanging electric lights, and will carry the name of the streets on each of its four sides in blue glass on a bright reflector background. The signs for the standing electric light posts will show the street names in stencil, while the great majority of the proposed new signs are designed for placing on the discarded gas posts, which stand useless and unsightly at so many street corners. The scheme to use those posts was suggested by the signmakers, who saw the opportunity for a great saving in the cost. The signs are not ornate, but they are neat, and the names can be seen without difficulty. The design is to place an X-shaped cross on each lamp post, the sides of the X bearing the names of the street or avenue they indicate. The proposed material is of enameled iron. A spear head will decorate the top of the post and a coat of paint will give to the whole a respectable appearance. Mr. Ahearn said that he was not much impressed by the beauty of the signs, but that handsome ones such as are in use in European cities would cost from $16 to $25 each, and he did not dare to ask the Board of Estimate to consider any such outlay. The money has now been voted.

COMPENSATED INDUCTION MOTOR.—Combinations of several types of commutator motors are embodied in an alternating-current motor for which a patent was granted December 13 to V. A. Fynn. The stator contains two windings, designated as the main and the auxiliary winding. The main winding is in all cases connected directly to the supply system without the interposition of any source of counter e.m.f. except that due to the rate of change of the core magnetism. As concerns this winding, therefore, the circuits are those of a stationary transformer, and the motor is a constant magnetism machine. The auxiliary or exciting winding, which is mechanically displaced somewhat upon the stator core from the main winding, is connected to brushes located upon the rotor commutator in the proper repulsion motor position with respect to the main winding. The arrangement is such that the phase and direction of the e.m.f. in the exciting winding corresponds with that induced in the rotor. The machine starts as a repulsion motor with the exciting winding either completely inactive or connected to the rotor brushes, while it operates at higher speeds as an induction motor, auxiliary slip rings and resistance being used in the secondary (rotor) circuit for this purpose. The rotor winding is composed of two parts, the main part corresponding to the ordinary direct-current type, through which both the induction and repulsion motor currents must flow, and a supplementary part through which only the induction motor current passes. The latter winding is interposed between the slip rings and the main rotor winding. These two parts lie in the same slots and are disposed relatively to each other in such a manner that the e.m.f. in the supplementary winding corresponds in phase and direction with the e.m.f. resulting at the points of connection between the two parts. The use of this method of construction is intended to eliminate the short-circuiting effect of the slip ring circuit upon the repulsion motor brush circuit.

MOTOR-REVOLVED STAGE.—At the big new Coliseum in London the stage alone is 85 ft. deep by 140 wide, and the central portion is fitted as a revolving stage, comprising three separate concentric tables, driven by electric motors, a plan which will be of great service in the production of spectacular effects that are to be made a specialty. Electric elevators will carry the audience to the upper portions of the house and to the roof garden.

ELECTRIC CANAL TOWAGE.—A Board of Commissioners was appointed under an act of the last Legislature to investigate the various proposed systems of electrical towing for the canals and report to the Legislature. It held a meeting this week in New York. The report of the committee on plan and scope, as originally presented at the last meeting of the board in Albany in September, was approved, with slight modification, and a committee was appointed to receive and investigate plans. The board then adjourned, subject to the call of the chair, but with the understanding that the next meeting shall be held in Albany about the beginning of the legislative session. After the board had adjourned, a meeting of the sub-committee appointed to receive plans was held, and it was decided that the committee should meet again on January 5, at the Murray Hill Hotel.

TROLLEYS IN SCOTLAND.—According to Mr. J. N. McCunn, United States Consul at Dunfermline, Scotland, a company has been formed there to build an electric railway through the west of Fifeshire. The promoters have given notice to the Fife County Council, the corporations of Dunfermline, Inverkeithing, Cowenbeath and Lochgelly of their intention to apply to Parliament in November for provisional orders to carry out the scheme. The stock will then be floated, and it is expected the company will begin the construction of the road in the spring of 1905. The road will be 16 miles in length, and besides connecting the towns mentioned will ultimately touch the new naval base, on the Firth of Forth. The estimated initial cost is $632,645. The Fife Electric Power Company, which is now building a power plant, will supply the current required for all purposes in the operation of the tramway system when completed.

HOSPITAL TROLLEY CARS.—Mrs. Caroline B. Alexander, her brother, Richard Stevens, of Castle Point, Hoboken, and Dr. M. F. De Hart, ex-president of the Jersey City Women's Club, representing a committee of the New Jersey State Charities Aid Association, have devised a plan for the establishment of a trolley car settlement for pauper consumption patients at Snake Hill on the Hackensack Meadows, New Jersey. The suggestion has been approved by many physicians in Hudson County, and it is believed that the Board of Chosen Freeholders, which has charge of the county institutions at Secaucus, will provide for the tuberculosis colony on the highest point on the hill. President Thomas McCarter, of the Public Service Corporation, has promised to place at the disposal of the committee several trolley cars whose days of usefulness are over. The cars will be taken to Snake Hill and placed on foundations at a considerable distance from the penitentiary, almshouse and lunatic asylums. The first patients to be admitted to the trolley car settlement will be consumptive men and women inmates of the almshouse. There are about twenty of each. It is believed that one car of the jigger type will accommodate two persons. Four or more will be made comfortable in the larger cars. The improvised fresh air hospitals will be fitted up comfortably.

LETTERS TO THE EDITORS.

The Wright Demand Meter.

To the Editors of Electrical World and Engineer:

SIRS:—I beg to correct a statement in regard to the Wright demand system of charging, which I find in the book by Mr. Lyman C. Reed, entitled, "American Meter Practice," which statement is very likely to give the reader a wrong impression of what that system is designed to accomplish.

On page 173 it is stated as an objection to the Wright system that "It is no inducement for a consumer to burn light when he does not need it, no matter how cheap it is." It can only be supposed from his statement of the above truism that Mr. Reed implies that it is the object of the Wright system to induce the consumer to use light when he does not need it. It is hardly necessary to say that it has no object so impracticable.

It is true that advocates of the Wright system have sometimes stated that it was the purpose of the system to encourage the consumer to use his lights for a longer time, and by some such careless statement Mr. Reed has evidently been misled. The real object of the Wright system is to induce the long-hour consumer of light or power to use electricity, and only electricity, to the exclusion of gas, kerosene and candles.

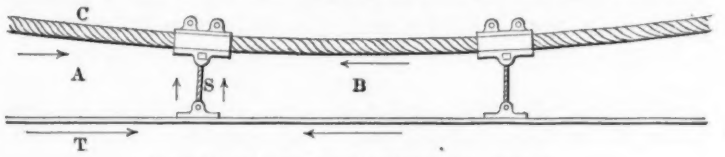
BOSTON, MASS. J. S. CODMAN.

An Alternating-Current Rectifying Effect.

To the Editors of Electrical World and Engineer:

SIRS:—In the modern form of high-tension trolley suspension for alternating-current railway work, there is a feature that has not been publicly recognized. I refer to the rectified current that flows in the suspenders between copper trolley wire and steel suspending cable.

Referring to the accompanying sketch, and to case *A*, where current flowing from left to right, the suspension cable and trolley being connected in parallel.



ALTERNATING-CURRENT RECTIFYING EFFECT.

By virtue of the inductance of *C*, there will be a lag in the rise of e.m.f. to a maximum relative to that in *T*, for equal distances, between the point of application and the withdrawal of energy. There will, therefore, be a balancing current from *T* through *S*. The balance will occur when the e.m.f. crosses the zero line.

Now take case *B*, with current flowing from right to left. The same action takes place and a balancing current will again flow from copper trolley up suspenders to cable.

PITTSBURG, PA. I. D. PATON.

Dimensions of Bus-bars.

To the Editors of Electrical World and Engineer:

SIRS:—I have read with much interest the letter of Mr. M. Freimark, in your issue of November 26, 1904, under the head, "Dimensions of Bus-bars," but as I do not agree with him on some of its points, I beg to present my views.

The lines 14 and 15 from it contain some errata and should read as follows:

$$c = \frac{s}{a} = 225 \quad 110 \quad 53 \quad 25 \quad 10 \text{ } cm.^2 \text{ } per \text{ } watt,$$

and "The loss of one watt requires a surface of 110 cm."

Later on Mr. Freimark speaks about the "mutual heating" of the divided bus-bars. I cannot see how a mutual heating can take place since both bars are supposed to carry the same current and therefore must have the same temperature. It is true, however, that the temperature of both bars increases somewhat in this case on account of the diminished circulation of the air in the narrow space between the bars. I agree with Mr. Freimark that this increase of temperature is unimportant, unless the space is very narrow.

Passing to the question of insulating the bus-bars by tape, it is by no means obvious to me that any considerable increase of the temperature can result from that. In 1884 Prof. Forbes concluded from theoretical considerations that under certain conditions an insulated wire will keep cooler than a bare one with the same load, and was proved by Dr. Kennelly experimentally in 1889, who found that bare paneled wires reached temperatures 30 per cent. higher than insulated wires under the same conditions. Oelschlaeger also found the same ratio in testing wires insulated with gutta-percha and bare wires in the open air.

There is no reason why these results should not hold good in the case of tape-insulated bus-bars. A short calculation will show this. The copper bar in Mr. Freimark's first example carries 800 amperes

and radiates per centimeter length .214 watt = .0514 gramme-calorie per second, with a rise in temperature of 10° C. Assuming 1 mm. thickness of insulation, we get a mean circumference of 21.6 cm. and an exterior circumference of 22.0 cm. With a coefficient of thermal conductivity of .0001, an extremely low value, we find the drop of temperature in the insulation $t = .0514 \times \frac{10^{-1}}{21.6.10^{-4}} = 2.4°$ C.

Since the surface of the tape is dull and that of a drawn copper bar is generally smooth, the thermal emissivity of the former will be the greater. Assuming that the ratio of these coefficients is 1.3—a value which is probably too low—the rise in temperature of the insulating surface will be $10 \times \frac{21.2}{22.0} \times \frac{1}{1.3} = 7.4°$ C. Therefore, the total rise in temperature of the copper = 2.4 + 7.4 = 9.8, or approximately 10° C., the same value found in the case of the bare copper bar. From this we may conclude that no considerable additional increase of the temperature can result from the insulation of the bus-bars, and I have never been able to observe any undue heating in this case.

SAN FRANCISCO. FREDERICK MEURER.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Compounding of Alternators.—WALKER.—An abstract of a paper read before the Manchester Section of the British Institution of Electrical Engineers on compensated alternating-current generators. After having dealt with various former designs of this kind, he describes a method of his own in which the field excitation is kept constant, and use is made of the armature reaction to strengthen the field as the load increases. Fig. 1 shows the arrangement. "Each

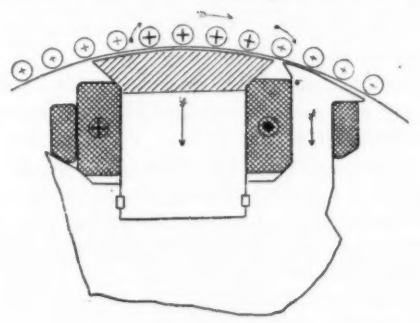


FIG. 1.—COMPOUNDING OF ALTERNATORS.

pole consists of at least two parts. The first is wound with a magnetizing coil, and there may or may not be another magnetizing coil placed round the two. (This second winding may be necessary for varying the normal voltage of the machine.) The broad pole is very highly saturated in the region marked with shaded lines, while the narrow pole on the right is unsaturated, and at no load is unmagnetized. The field rotates counter-clockwise, and the pole is supposed to be a south pole. Hence, it gives rise to an e.m.f. in the conductors above it, which is in the sense indicated by the crosses; that is to say, down through the paper. Any current in the armature which is in phase or nearly in phase with this e.m.f. will tend to demagnetize the saturated part of the pole and magnetize the unsaturated part, but the flux in the saturated part cannot be changed to any great extent, while the unsaturated part becomes highly magnetized by armature reaction and increases the e.m.f. of the armature." It is stated that the British Westinghouse Company has thoroughly tested the machine and finds that with a power factor of 0.85 it can be made to hold its voltage from no load to full load, and the increase of e.m.f. on increased load is instantaneous. With a power factor above 0.9 a considerable overcompounding can be guaranteed.—Lond. *Elec. Times,* December 8.

REFERENCE.

Transformers.—HIECKE.—A mathematical article on the calculation of lighting transformers with some critical remarks on formulas of Arnold and La Cour. He deals especially with the determination of the ratio of the weight of iron to the weight of copper so as to make the economy a maximum.—*Zeit. f. Elek.* (Vienna), November 13.

LIGHTS AND LIGHTING.

Mean Spherical Candle-Power of Incandescent and Arc Lamps.—DYKE.—An abstract of a British Physical Society paper in which the author points out the need of an improved method of expressing the efficiency of glow lamps, and adopts the suggestion of Fleming of expressing the whole flux of light in lumens per watt. The expression of the efficiency in this manner involves the determination of the mean spherical candle-power (m.s.cp) and the paper describes a method of doing this. The objects of the paper are, first, to obtain curves showing the variations of candle-power of glow lamps in a horizontal plane; second, to obtain reduction factors by which the mean horizontal candle-power (m.h.cp) may be calculated from the maximum horizontal candle-power (cp), and third, to obtain reduction factors for deducing the m.s.cp from the m.h.cp and from the cp. A self-contained, motor-driven lamp holder is described which rotates the lamp about a vertical axis at from 230 to 300 r.p.m. The m.h.cp was determined by spinning the lamps and by taking cp.s. in different azimuths by a step-to-step method. The results agreed within the limits of experimental error, thus showing that the filaments were not sensibly distorted during rotation. An integratng photometer was used to determine the ratio of the m.s.cp to the m.h.cp. The instrument is of the type suggested by C. P. Matthews, and consists of several pairs of mirrors placed around the circumference of a semi-circle, and so arranged that light emitted from a source placed at the center of the system is incident upon the photometer screen, also situate at the center, at the same angle with the vertical as it made on emission from the source. It is shown how the ratio of the m.s.cp to the m.h.cp can be determined by observing one distance after obtaining a photometric balance. The effects of any departure from Lambert's cosine law, and of varying reflection coefficients of the mirrors were investigated and allowed for. It was also found impossible to reduce the size of the apparatus by interposing ground glass screens because of the varying absorption of ground glass for light of different colors. Nine types of glow lamps were experimented upon and the high peaks and depressions on the curves of horizontal intensity were ascribed respectively to a mirror action of the bulb and to portions of the filaments obstructing the light from other portions. Values of the ratios of m.h.cp to cp, of m.s.cp to cp, and of m.s.cp to m.h.cp, have been obtained and for lamps of the same type of filament it is found that the ratio of m.s.cp to m.h.cp is remarkably constant. The author, therefore, suggests the determination of the m.h.cp by means of a rotator, and then, with the aid of a reduction factor, determined once and for all for a particular type of filament by an integrating photometer, the deduction of the m.s.cp. Preliminary experiments upon arc lamps seem to show that a similar method may be adopted for the determination of their m.s.cp. In the discussion Patterson said that the results of the author were in close agreement with those obtained at the British National Physical Laboratory. Duddell thought that the integrating photometer described in the paper was very cumbersome and not superior to Blondel's lumen meter.—Lond. *Elec.,* November 25.

Three-Phase Arc Lamps.—A note on experiments made with a three-phase arc lamp designed by two Milanese engineers, Bentivoglio and Siciliani. For regulation two opposed rotating fields are used. If one of these is in series with, and the other is in shunt to, the carbons it is evident that a Ferraris disc or its equivalent can be made to rotate in one direction or the other, and work a screw and ring arrangement which pulls the carbon ends nearer or farther

apart, according to the amount of current passing. The lamp is under trial at the Milan technical school, and is said to work excellently. From the construction, however, it would look to require the use of rather short carbons.—*Elettricista,* page 312; Lond. *Elec. Times,* December 1.

REFERENCE.

Osmium Lamp.—Among the exhibits at the recent anniversary of the Berlin Electrical Society, there were horizontal osmium lamps made by the German Incandescent Gas Light Company. These lamps are now made in capacities of 16, 25 and 32 candles for voltages between 19 and 47.—*Elek. Anz.,* December 4.

POWER.

Electric Hauling Plant at Collieries.—An illustrated description of the electric winding plant at the Ligny-les-Aire mines which is capable of hoisting 105 tons of coal per hour from a depth of 1,312 ft. at a speed of 26.2 ft. per second. Each cage provides accommodation for four trucks having an aggregate capacity of 4,900 pounds. Since one hoist occupies 60 seconds and the loading and unloading of the cage another 15 seconds, it follows that 48 hoists may be made per hour. The cable drum is driven directly by two 250-hp motors. When the cage starts its journey the motors have to work at the rate of about 600 hp, but this falls to about 300 hp when the proper speed is reached. Naturally, these wide fluctuations would, if no other arrangements were made, necessitate a larger generating plant than would correspond to the average power consumed, and in order to level the power demanded to a constant value of about 300 hp a special set of motors and generators is provided in the central station. A diagram of connections of this power-regulating device is given in Fig. 2, where *A M* denotes a dynamo, termed the

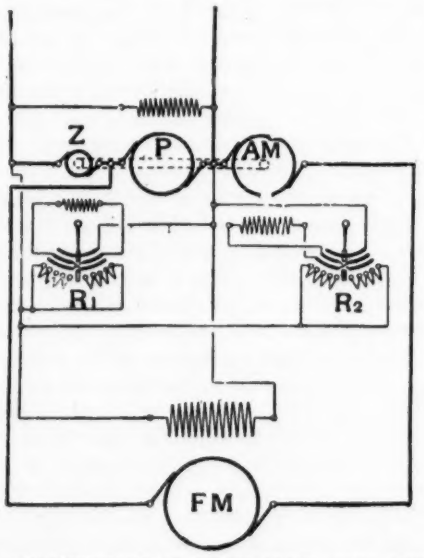


FIG. 2.—CONNECTIONS OF POWER-REGULATING DEVICES.

"starting" dynamo; *P* is the so-called "buffer" motor, while *Z* is a booster. These three electric machines, together with a fly-wheel, are keyed to a common shaft. When the winding motors, represented by *F M* in Fig. 2, are at rest, the starting dynamo, *A M*, which is connected in series with the line, has a voltage equal to, but opposite in sense to that of the supply. The pressure across the terminals of the hoisting motors is, therefore, at this period nil. When, however, these hoisting motors are to be started, the excitation of the dynamo, *A M*, is gradually weakened, the effect being, of course, to increase, proportionately, the pressure at the terminals of the hoisting motors. After the excitation of the dynamo, *A M*, has been completely suppressed, the hoisting motors run at half their normal speed. In order, now, to further increase the motor speed, the excitation of the dynamo, *A M*, is reversed and gradually strengthened. It is evident that by doing this the pressure of the dynamo is added to that of the supply, the final voltage at which the motors are fed being some 1,050 volts. The motor, *P*, which drives the dynamo, *A M*, is shunt-excited and connected in series with the booster, *Z*, to the power mains. By varying both the value and the direction of the voltage of this booster, the speed of the set, *A M*, *P* and *Z* may be regulated within 30 per cent. On reducing the speed of this set, the fly-wheel gives up some of the energy stored in it, thus reducing the demand on the central station. —Lond. *Elec.,* December 2.

Power Plant of Office Buildings.—Knowlton.—A description of the mechanical plant of the 11-story Oliver building, in Boston, which is served by a steam plant consisting of four 150-hp Scotch marine-type boilers with Morison corrugated furnaces. There is an electric generating plant consisting of four direct-connected sets aggregating 225 kw, a refrigerating plant for cooling drinking water and five direct-acting plunger-type hydraulic elevators, besides the usual equipment of pumps for boiler feeding for handling returns and for the general water supply of the building. The same issue contains an article on the electrical and mechanical equipment of the 19-story Arthur building in New York, enclosing 1,150,000 cu. ft. of space. It is served with both electricity and steam from the public supplies. There is a total connected load of 2,000 lamps of 16 cp equivalent and about 250 hp in motors. There are about 35 sq. ft. of rentable floor per 16-cp lamp, or one such lamp per 575 cu. ft. of the building's contents. There are two continuous-rope electric elevators and two drum-type electric elevators. There is one elevator per 840 sq. ft. of rentable floor area on each floor. The continuous-rope machines average 27.5 car miles per day, with an average consumption, determined by test, of 4 kw per car mile, while the drum machines average 21.66 car miles and the consumption is 4.95 kw per car mile. There is an electrically-driven 5 x 6-in. triplex pump for the water supply, with a steam-actuated auxiliary, and water is used at the rate of 12.5 gallons per 1,000 cu. ft. of the contents of the building per day for 365 days. Direct radiation is used for heating and there is a ratio of contents to heating surface, on the basis of the entire building, of 100 cu. ft. of space to 1 sq. ft. of radiation.—*Eng. Record,* December 17.

REFERENCES.

Efficiency.—Shortav.—A brief article on the calculation of the total efficiency of a direct-current electric power transmission plant. —*Elek. Anz.,* December 1.

European Regulations Regarding Steam Superheaters.—Report on foreign regulations, including the provision of the Prussian police code, the principles adhered to by the Manchester Steam Users' Association and the views of Lloyd's Registry, of London.—*Eng. Record,* December 17.

TRACTION.

Electric Truck.—Timmis.—A full account of a test made with three electric trucks of standard manufacture for delivering merchandise from Brooklyn to New York. The test extended over a period of four months. The cost per ton-mile, estimating 40 per cent. mileage as returning empty, comes out as 35.5 cents. "The cost per ton-mile on the Lake Shore & Michigan Southern Railroad for the past six years has been 5.25 mills, which clearly shows a large margin in favor of a smooth metal road and a dependable motive power." The author then gives a comparison of the cost of running an electric truck and of horse traction. "Under the conditions of load and character of delivery it is thought that three two-horse trucks will be able to do the same amount of work as the three electric trucks as shown up in the result of these tests." From actual experience he states that the cost to run one two-horse truck per year is $1,417.66, while the cost to run one electric truck per year is $2,300. The latter cost is made up as follows: interest and depreciation, $200; automan, $780; charging batteries, $240; tires, $270; motor repairs, $20; batteries, repairs and renewals, $650; running gears, $140. "It will be seen that much remains to be done before the electric truck will drive horses from the streets, at any rate the horses used for business purposes."—*Amer. Mach.,* December 22.

Jungfrau Railway.—A note on the new locomotives for the Jungfrau Railway. They are somewhat stronger, but otherwise similar to the old locomotives. Each locomotive weighs 16.8 tons and is operated by two three-phase motors, each of 110 kw at 450 to 600 volts, the number of revolutions being 760 per minute. The speed is 8.1 km. (5 miles) per hour. With the old locomotive two speeds could be obtained while with the new ones each of these two speeds can be varied within 5 per cent. In running up the mountain the motors operate as induction motors, while in running down they operate as self-exciting generators. Besides the three slip rings they are provided with a collector with two brushes connected to the braking resistances which also serve as starting resistance.—*L'Industrie Elec.,* November 10.

REFERENCES.

Trolley Arrester.—An illustrated description of a device designed to control the trolley pole when, by any accident, it leaves the overhead wire, and, by sudden upward movement, fouls the spans or becomes entangled in other portions of the overhead equipment. As soon as the trolley wheel leaves the wire, an auxiliary electric circuit is closed, which energizes an electromagnet, and the result is that the trolley pole is immediately drawn down sufficiently to clear the span wires or other overhead construction. The electrical energy required for working the device is supplied from the bell battery on the car.—Lond. *Elec.*, November 25.

Traction Curves.—SARRAT.—An article describing a method of Pforr for investigating traction problems with the aid of diagrams. —*L'Eclairage Elec.*, December 3.

Paris.—An illustrated description of recent extensions of electric traction on the Paris terminal of the Paris-Orleans Railway.—Lond. *Elec. Rev.*, December 2.

Automobiles.—SOLIER.—An illustrated description of electric automobiles for transportation of mails in Paris.—*L'Eclairage Elec.*, December 3.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

American and British Practice in Electricity Supply.—TAITE.—His presidential address to the Manchester local section of the British Institution of Electrical Engineers on the points of difference in central station practice in the United States and in Great Britain. The business started in both countries from small beginnings, the main point of difference being that in America all wires and cables were run above ground, while almost from the earliest days both feeders and distributors in Great Britain were laid underground with few exceptions. When the use of electricity increased, competition in the supply business was prohibited in Great Britain with the sole exceptions of London and New Castle, and one provisonal order only was granted for each city, town or district. In the United States, on the other hand, a town of the size of Chicago or Philadelphia would be divided up among quite a number of companies, often operating with quite different systems. The development was more rapid in the United States and to this early success of supply undertaking the author attributes the almost universal system of supplying direct current at a pressure of 110 to 120 volts for lighting and 230 volts for motors, as compared with the British practice of 220 to 250 volts for lighting and 440 to 500 for power. The Americans did not make the change to the higher voltage, and "probably will never do so now." The result is that American distributing systems—so far as they are laid underground —are, at the present time, very much more expensive than English ones, and where the supply necessitates sub-stations and transformation from high-tension, three-phase to low-tension, direct-current, sub-stations have to be much more frequent than in England. Gradually the different companies operating in one American city were consolidated so that "by a series of developments America has arrived at a point which our authorities foresaw from the first, and provided for by refusing to sanction more than one provisional order for a given area." The author then says that in England they are rapidly becoming converted to the advantages of steam turbines for driving large units, particularly for alternating-current work, and emphasizes two advantages, namely, the great capacity they have for overloads and the saving in capital expenditure. He does not think that in America the turbine is making such rapid headway, the Boston and Chicago turbine stations being mentioned as exceptions. The author is impressed by the complete system of oil-brake, motor-driven switches with electrical remote control in use in connection with large units in America. He was also struck by the attention which is given in the United States to the personal comfort of the staff of central stations. He thinks it is strange that in the United States, where labor-saving devices are specially favored, the question of mechanical stokers versus hand-firing has not yet been definitely settled. Experience seems to show that the quality of the labor required for the mechanical stoker is quite as high as for hand-firing, but the quantity required is less. The fact is the burning of coal—if the best results are to be obtained—requires close attention and strict supervision, whatever be the means adopted for feeding the furnace. For transmission, three-phase current is generally used in the United States with a three-wire, direct-current system at 2×110 volts to the consumers. He thinks that the question of speed regulation has a great deal to do with the latter system and that a higher efficiency was formerly claimed for the 110-volt lamps than for lamps of the double voltage. "The latter argument was undoubtedly one of considerable force in this country years ago, when the first changes to the higher pressure were being made, but at the present day there is little to choose in efficiency between lamps of 110 and 220 volts, and the saving in capital expenditure, not only on the cable system, but also in the house of consumers, makes the higher pressure undoubtedly the most economical for both supplier and consumer. Electricity is in much more general use in America for all purposes than is the case in England in spite of the fact that in the large cities at any rate, the price charged is considerably higher than in England. Municipalities in the United States have not cared to take up themselves the supply of electricity to the same extent as in England, but have given instead franchises. The fact that the lamp question has been solved in America by giving the consumer free lamps has brought about the result that the consumers get a thoroughly satisfactory light with a minimum expenditure of current. But the system has its drawbacks, thus the consumer being assured of a free supply of incandescent lamps, has very little encouragement to any new type of lamp, such as the Nernst, and it is a fact that in America so small is the demand for Nernst lamps where direct current is supplied, that a design suitable for direct current has not yet been put upon the market. Generally speaking, the average American has a much higher appreciation of electricity for all purposes than the average Briton; he has appreciated its virtues and has adopted it accordingly. In America the coal bill is low, due to the use of large and economical units, but the capital expenditure per kilowatt installed is high, owing to the charges which have had to be made in assimilating the systems of the various companies and in effecting the consolidation. From the companies' point of view, the position is a satisfactory one, as a monopoly has been established, but from the point of view of the consumer it will be some years before he feels any financial benefit from the process of evolution which has taken place. This experience emphasizes in a marked degree the necessity for careful finance with regard to capital expenditure.—Lond. *Elec.*, November 25.

Paris.—An article on the future of the central station business in Paris when the present franchises have run out. In 1907 the franchises of four companies will run out; they use direct current, one employing a two-wire system, one a three-wire system, and two a five-wire system. Two companies organized at a later date and supplying the outlying districts use alternating current. There appears to be an agitation in the Paris press recommending lower prices for electrical energy. The present article gives a review of the subject and invites its discussion. The present anonymous writer appears to favor the renewal of the franchise for a certain length of time, with such maximum prices as to enable the companies to earn enough money to surrender the complete system to the municipality at the end of the contracts. They should also get the right to consolidate; this they would undoubtedly do to introduce a more uniform system throughout the city. The author argues that in this way the municipality would be the winner in the end.—*L'Industrie Elec.*, November 25.

REFERENCE.

Starting and Regulating Resistances.—LINDENSTRUTH AND FORSTER.—An illustrated translation in abstract of their recent French article on some modern types of cheap and compactly-built metal resistances for starting and regulating purposes.—Lond. *Elec.*, November 25.

ELECTRO-PHYSICS AND MAGNETISM.

Secondary Radiation.—EVE.—An account of an experimental investigation of the secondary radiation caused by the β and γ rays of radium. It appears probable that Röntgen, β and γ rays all produce secondary radiations of the Röntgen type, as well as those of the β type. The γ rays either consist of particles practically devoid of electric charge or are of the type of Röntgen rays or have a special character of their own, hitherto unknown. The dissimilarity between Röntgen and γ rays in connection with the ionization of gases and vapors, and in the character of the secondary radiations, is probably due to the fact that the Röntgen pulses are more broad than those which constitute the γ rays. The differences are decreased when harder bulbs are used, and the resulting pulses are more thin. Theoretical reasoning still supports the view that the expulsion of the β particles must be accompanied by pulses similar to those set

up on the stoppage of the cathode particles; and, until there is definite evidence to the contrary, it is reasonable to suppose that these pulses, analogous to the Röntgen rays, constitute the γ rays.—*Phil. Mag.*, December.

REFERENCE.

Molecular Attraction.—MILLS.—A third paper on this subject. The results appear to confirm his former law of attraction (quite analagous to Newton's law) and show that the ratio of the difference of the latent heat of vaporization and the energy spent in overcoming external pressure to the difference of the third roots of the density of liquid and vapor respectively, is a constant for normal constituted substances, and that this equation is applicable with equal exactness in the immediate neighborhood of the critical temperature. He also discusses at some length a formula by Crompton.—*Jour. Phys. Chem.*, December.

ELECTRO-CHEMISTRY AND BATTERIES.

REFERENCES.

Electrolytic Dissociation Theory.—KAHLENBERG.—A long abstract of a Faraday Society paper in which he sums up the arguments against the dissociation theory, together with a review of the discussion which followed and from which, according to the *Elec. Rev.*, "the theory certainly emerged triumphant," while the *Elec. Times* seems to think the other way.—Lond. *Elec. Times*, December 1; Lond. *Elec. Rev.*, December 2.

Storage Battery.—HOMMEL.—An illustrated account of tests of a new lead storage cell, called Climax accumulator, and made by a Berlin Company. The results are given in diagrams and tables.—*Elektrochem. Zeit.*, November.

Electrolytic Dissociation.—HOPKINS.—An illustrated popular article on the theory of electrolytic dissociation, on the laws of osmodic pressure and the principle of Soret.—*Scientific Am. Supplement*, December 17.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Pyrometry.—WAIDNER AND BURGESS.—A very full discussion of the principles of radiation pyrometry, with a description of the more usual pyrometers of this type, especially those of Le Chatelier, Wanner, Holborn and Kurlbaum, Morse and Fery. They conclude that no one instrument can claim a decided superiority as to precision, certainty and ease of calibration, permanence of indications and range. All of the instruments mentioned above are capable of accuracy of one per cent. in temperature measurement in the ranges for which they are adapted for use, although this accuracy is not attained with the same ease in all cases. It is possible to control a given temperature or measure temperature differences much more exactly than reproduce absolutely any temperature. For relative temperature measurements the precision attainable is better than one per cent., except possibly for the Fery absorption pyrometer, and may be even as good as 2 per cent. at 1,500° C., with the Holborn-Kurlbaum pyrometer. The lowest temperature measurable optically is about 600° C., which may be reached with the Le Chatelier, Holborn-Kurlbaum and Morse instruments. The Wanner pyrometer and the Fery thermo-electric telescope cannot be used below 900° C. Regarding the upper limit, there is none except for the Morse, which is difficult to use above 1,100° C.; but for very high temperatures, above 1,500° C., where they can only be determined by extrapolation in terms of some radiation law, the most reliable results will be given by those pyrometers obeying one of these laws the most exactly. The only instrument which can readily be made recording is the Fery thermo-electric telescope. The authors finally give the results of their determinations of the "black body temperatures" of a number of substances and discuss the polarization of light from incandescent surfaces, the effect of diffuse and reflected light and the measurement of very high temperatures. From their work it would seem that the radiation laws are still in agreement at the temperature of the arc. The same issue contains an article by Hartman on the limitations in the use of the Wanner pyrometer showing that this instrument is to be used with caution in measuring the temperatures of small narrow sources such as incandescent rods or wires.—*Phys. Rev.*, December.

Iron in Alternating-Current Instruments.—SUMPNER.—The first part of his presidential address to the Birmingham Section of the British Institution of Electrical Engineers, in which he discusses at great length the use of iron in alternating-current instruments. Alternating-current measurements cannot be made with the same accuracy as direct-current measurements. He believes the result is almost entirely due to the fact that for alternating currents there is no instrument at all comparable in sensitiveness with the galvanometers and voltmeters available for direct-current work. It is to the use of permanently magnetized steel that direct-current instruments owe their great sensitivenss. Whether of the fixed coil or moving coil types, galvanometers may be described as single-current instruments in which the deflecting force is proportional directly to the current or voltage applied. Unfortunately, all alternating-current instruments have the characteristics of the double-current type, in which the deflecting force is proportional to the square of the current or voltage. In order to make alternating-current instruments as sensitive as the corresponding direct-current ones, a strong magnetic field must be produced and the problem resolves itself into an inquiry into the condition under which iron-cored electromagnets may be introduced into such instruments, without involving errors due to difference of phase frequency, wave form, etc. He first discusses the construction of phasemeters and explains their action in a novel way, pointing out that they really act by means of rotating fields. On the basis of this idea he has designed some instruments with a special endeavor of providing a strong alternating magnetic field. In one of the phasemeters made by him the fixed coils are wound through circular ring stampings just as in the stator of a three-phase motor. There are three coils, each of eight turns, wound with wire siutable for 5 or 6 amp., with each coil brought to a separate pair of terminals. The portion corresponding with the rotor consists of a cylindrical block of circular stampings held in a fixed central position, and unwound. In the air-gap between the two is placed a pivoted coil similar to those used on moving coil galvanometers or voltmeters, but without control. It is capable of free motion about the axis of the instrument, and its position is indicated on the scale by an attached pointer. The position taken up by the pointer is quite definite under any given circumstances, and if the coil is moved out of its equilibrium position the forces tending to make it return are considerable, in spite of the fact that a very large non-inductive resistance is used in series with the pressure coil. The author then gives a hint as to the insertion of a reversing switch between the power factor indicator and the mains, so as to render possible accurate phase readings with very low power factors. He then passes over to the consideration of wattmeters. The paper is to be continued.—Lond. *Elec.*, November 25.

REFERENCES.

Mean Spherical Candle-Power of Incandescent and Arc Lamps.—See the abstract of Dyke's paper under "Lights and Lighting."

Carbon.—PERKINS.—A fully illustrated article on the manufacture of electric light carbons and battery carbons in England.—*Scientific Am. Supplement*, December 17.

MISCELLANEOUS.

Berlin Electrical Society.—A review of the work done by the Berlin Electrical Society, which celebrated recently the 25th anniversary of its foundation. The society has now between 1,600 and 1,700 members, and forms the chief constituent of the association (Verband) of German Electrical Engineers, which comprises now 15 societies, and has more than 3,400 members.—*Elek. Zeit.*, December 1.

German Manufacturing Company.—A long abstract of the annual report of the Allgemeine Elektricitäts Gesellschaft, in Berlin. The number of employes is now 27,487. The company has developed a new type of turbo-dynamos for all different capacities. Two machines for use on shipboard, of together 6,000 hp, will be installed next spring. The company has developed several new forms of Nernst lamps. This lamp will be built in future in a separate factory, 800 workingmen being employed there. The incandescent lamp factory employs 793 workingmen. The single-phase traction motor of the Union Electric Company has been further developed and is used on the Spindlersfelde experimental road, the single-phase voltage being 6,000. The Stubaital road, near Innsbrück, is now being operated with the same system. The company has worked out, together with the Siemens & Halske Company, the project of a high-speed electrical road from Berlin to Hamburg.—*Elek. Anz.*, November 24 and 27.

REFERENCES.

Electric Ignition of Explosion Motors.—LOEWY.—An illustrated description of a great many different methods of electric ignition of explosion motors.—*Zeit. f. Elek.* (Vienna), November 27.

Some Refinements of Mechanical Science.—SWASEY.—The full presidential address before the American Society of Mechanical Engineers, discussing historically the measurement of time, the division of the circle and the measurement of angles, and concluding with the production of diffraction gratings.—*Eng. Record,* December 10.

Magnetic Separators.—CRANE.—An illustrated article on electromagnetic separators of the secondary induction type; that is, of the type in which the mineral is not acted upon directly, but indirectly, through one or more secondary magnets which receive their magnetism by induction from primary magnets and are passed between the same and the mineral treated. This is claimed to produce a more complete control of the magnetizing poles. The Knowles magnetic separator is described in detail. The same issue contains also an article on magnetic separation of iron and zinc ores.—*Mines and Minerals,* December.

New Westinghouse Crane Motor.

The Westinghouse Electric & Manufacturing Company has put forth a new motor, known as "Type K," designed for the operation of cranes, hoists and similar apparatus and for intermittent service in which heavy starting torques and wide speed variation are required. The motor represents the latest development and includes some of the most recent improvements in machinery of this kind, while many new features of the highest practical value have been incorporated in their construction. They are strong and compact, convenient to install, adaptable to every practical form of mounting, and are reliable, economical and powerful in operation. Ten sizes are standard, including capacities from 2 to 40 hp.

The frames are of the wholly enclosed form, to guard against dirt and moisture, but are so designed that the working parts may be exposed for inspection or adjustment without dismantling. If local conditions permit, the cover about the commutator may be removed and the motor operated open, with improved ventilation and increased capacity. They have four inwardly projecting poles, each of which is magnetized by a separate field coil. The motor is series

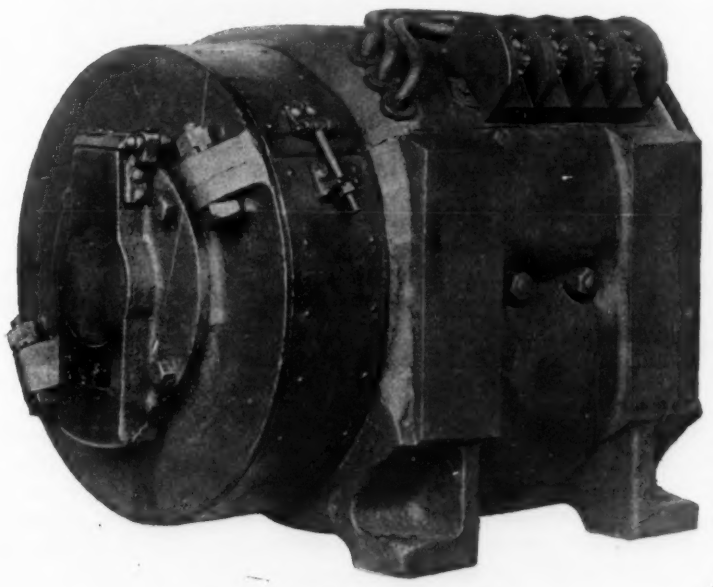


FIG. 1.—25-HP CRANE MOTOR.

wound and is designed for operation on direct-current circuits of 220 and 500 volts. Since the current passes successively through armature and field winding, the torque of such a motor increases nearly as the square of the current, up to the point of saturation of the iron. For this reason the series motor is particularly well suited to the starting and acceleration of heavy loads. Governed by change of voltage at the motor terminals, the speed of the motor is carried through a wide range, the change in the resistance of the motor circuit being made by means of a controller.

The motor frames are of cast steel (except in the three smallest sizes, where they are cast iron). They are extremely compact, nearly square in section and require the smallest possible amount of headroom on a crane, or floor space when used with hoists or similar apparatus. Two poles project inwardly in a horizontal and two in a perpendicular plane, this arrangement being the most compact possible with a four-pole motor. The frame is built in two parts, divided in a plane passing through the axis of the armature and at

FIG. 2.—CRANE MOTOR WITH UPPER FIELD RAISED.

an angle of 34° with the horizontal, an arrangement which allows the upper half of the field to be removed without disturbing the gears or shaft, and makes it easy to take out a pole piece and field coils, or to remove the armature. The lower half of the frame has four feet, with holes for bolting to the support, providing the smallest base consistent with good engineering practice. The lower casting has also two finished faces or pads to which bearings for a countershaft may be bolted, or which may be used for side mounting. The commutator end of the frame is connected to the poles by six ribs, any two of which may carry the brush holders. The opening around the commutator is entirely closed by a 3/32-in. sheet-steel band, fastened by thumb-screws, an arrangement which permits access to the commutator and brush holders at all points.

The four pole pieces are built up of soft steel punchings riveted together between wrought iron end plates, and are secured to the frame by bolts which pass well into the punchings, but leave the pole face smooth and unbroken. The coils of the larger motors are of copper strap and the terminals are insulated with asbestos ribbon. Being machine wound, they are perfectly interchangeable. The coils are fitted to the pole pieces, protected at the ends by oiled duck and held in place by the spreading tips of the pole pieces.

Shells lined with bronze or babbitt and mounted in housings which may be removed without separating the motor frame, constitute the bearings. Cast brass bearings are standard on all sizes up to and including the No. 4; on all frames above No. 4 babbitt bearings are used. Grease lubrication is employed in all except the larger

sizes, the bearings of which are designed for lubrication by oil and waste. Drip cups are provided under the bearings for all motors. The bearing housings may be turned and bolted in several positions without modifications of design or the addition of special parts.

The commutator is mounted on the armature web, allowing the shaft to be removed without disturbing the winding or connections. The coils are placed in slots and retained by bands laid in grooves below the surface of the core, except in the case of armatures for the Nos. 9 and 10 motors, which have fish paper wedges forced in between V-shaped grooves near the top of the slots. Covers of oiled duck protect the ends of the winding. Wiper rings or oil guards are provided at each end of the armature to protect the winding from oil. The shafts are of great strength and may be extended at either end to accommodate pulleys, pinions or brake discs.

The brush holders are of the sliding type and possess many special

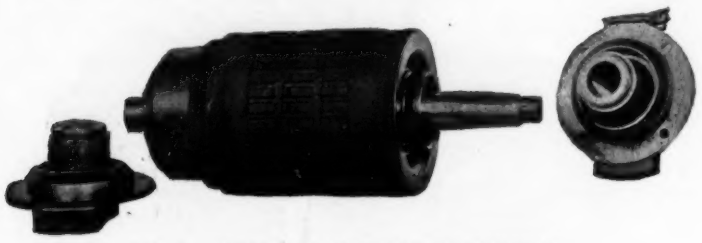


FIG. 3.—ARMATURE AND BEARING HOUSINGS.

features. The individual holders may be independently adjusted. Tension is provided by means of a coiled spring which acts through a short brass strip, so that the spring responds immediately to any movement of the brush, and close contact is maintained at all times. The brush holder arms are secured by stud bolts to surfaces which are machined on the ribs of the frame, parallel to tangents at the points of contact with the brushes. Adjustment to compensate for

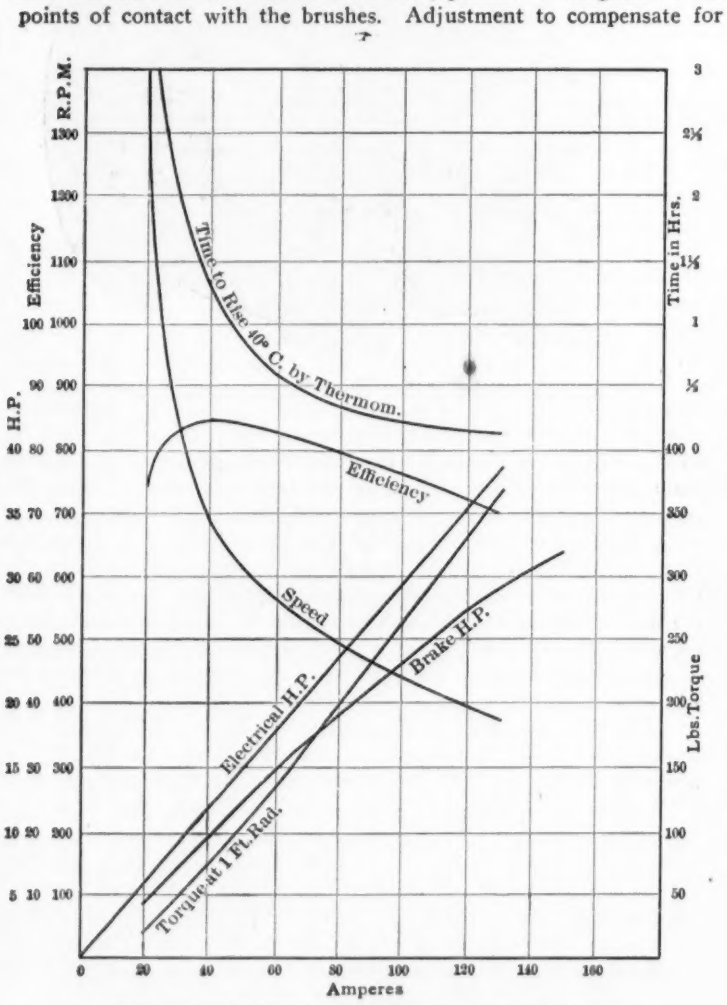


FIG. 4.—CHARACTERISTIC CURVES OF CRANE MOTOR.

wear of the commutator can be made by removing the iron washers which are placed under the insulating washers on the stud bolts.

With all but the two smaller sizes a shunt is connected to the tip of the spring, extended back over the spring and securely fastened to the brush holder, thus relieving the spring of the duty of carrying current, insuring good contact, low operating temperature and a permanent and even tension. With every carbon brush 5/8 in. or more in thickness an additional sheet is provided connecting the carbon itself to the carbon holder, improving the contact between carbon and holder and preventing that pitting of the brush which is so annoying and troublesome, besides offering a further protection to the temper of the spring. Flexible leads are brought out through

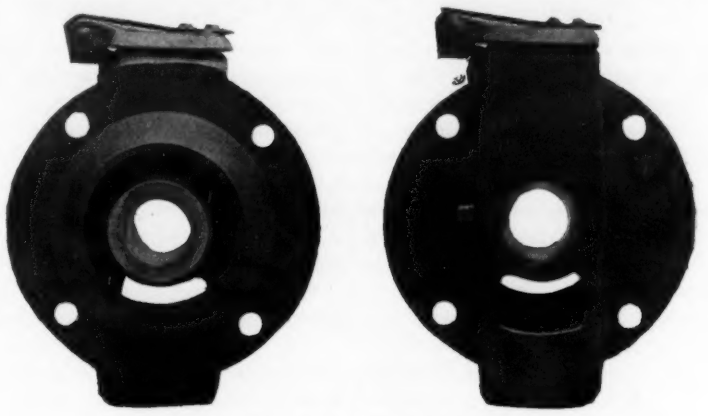


FIG. 5.—BEARINGS AND BEARING HOUSINGS.

insulating bushings in the upper frame and are either connected to terminal blocks mounted on the top of the motor, or are arranged for direct connection to the controller lines.

Wireless Telegraphy on Coastwise Steamers.

Two Mallory Line steamers, the *San Jacinto* and the *Denver,* have been fitted out with wireless telegraph apparatus by the Atlantic De Forest Wireless Telegraph Company. The *Denver* arrived at New York from Galveston on December 21, this being her first trip with the wireless equipment in working order. The details below as to the tests have been given to us by the De Forest Company.

After leaving Galveston, the first point the *Denver* communicated with was Key West, while 170 miles out at sea, and she was in constant communication until her arrival at that port. On resuming her voyage north, she kept in touch with the Key West station until she was 200 miles north. When 140 miles north of Key West the *Denver,* it is stated, heard the company's New York station testing with the *San Jacinto,* which then lay at her pier in New York. The distance between the New York station and the *Denver* at sea at this time is given as 900 miles. Continuing northward the *Denver* picked up the Hatteras station, 200 miles off, and also the *San Jacinto,* 170 miles away, and was in communication with both all day Monday, December 19. Tuesday morning, while off Cape Henry, the *Denver* heard the De Forest station at New York and at 3 p.m. New York was working with her 60 miles south of Scotland Lightship and communication was kept up until she dropped anchor at Tompkinsville Tuesday night.

The *San Jacinto* left New York Sunday, December 18, at 7.45 a.m. and the New York station at 42 Broadway was in communication with her until 1 p.m. She was then 90 miles down the coast. Hatteras picked her up 358 miles away, before New York let go, and she was in constant communication with Hatteras till late Monday night.

It is stated that the Cleveland and Buffalo stations are getting the New York stations perfectly. Cleveland is at about 600 miles overland from New York.

Changes in the L. E. Myers Company.

On January 1, 1905, important changes will take place in the L. E. Myers Company, of Chicago, engaged in the construction and operation and management of electric railways. After the date mentioned, Mr. Theodore P. Bailey, who for a number of years has been assistant manager of the General Electric Company in the West, will become vice-president and general manager of the L. E.

Myers Company. Mr. Myers will continue as president and Mr. C. E. Collins, who has been in charge of the construction work of the company, as general superintendent. Mr. William H. P. Weston, formerly secretary of the company, is to become treasurer as well. The company has in its organization specialists in every department required for complete electric railway construction. It has within the last year completely constructed the system of the Topeka Railway Company, including the erection of five buildings, and is now managing the property. It has branch offices at Topeka, Kan.; Dubuque, Iowa, and Springfield, Ill. The latter office is headquarters for the construction during the coming season of the Springfield & Northeastern Railroad, which is to comprise in all 111 miles of track, of which 60 miles connect Springfield, Ill., with Bloomington, and runs parallel with the Chicago & Alton Railway. From Lincoln, which is about midway between Springfield and Bloomington, a branch is to be run to Peoria. The power house will be at Lincoln. It is understood that the single-phase system is to be used.

The Cicero Light, Heat & Power Company, of Oak Park, a suburb of Chicago, is one of the companies managed by the L. E. Myers Company. The Peoria & Pekin Terminal, the Canton-Akron and Canton-New Philadelphia roads are among those constructed by this company. Mr. Bailey's intimate acquaintance and standing in the railway and lighting business, together with the financial and executive ability already in the L. E. Myers Company should make this already strong concern stronger if possible. The company's offices in the Monadnock Building, Chicago, will be enlarged to include the suite 1115 to 1119.

The Sargent Gas Engine.

The accompanying illustrations refer to an interesting type of gas engine known as the Sargent complete expansion gas engine. In this engine the charge is expanded practically to atmospheric pressure, the point of cut-off of the admission inlet is varied with the load, and the time of ignition is advanced as the mixture gets weaker and the inflammation slower. The advantages which these points insure over the ordinary type of gas engines are claimed to be increased efficiency, increased regulation in speed and smooth running under early cut-offs.

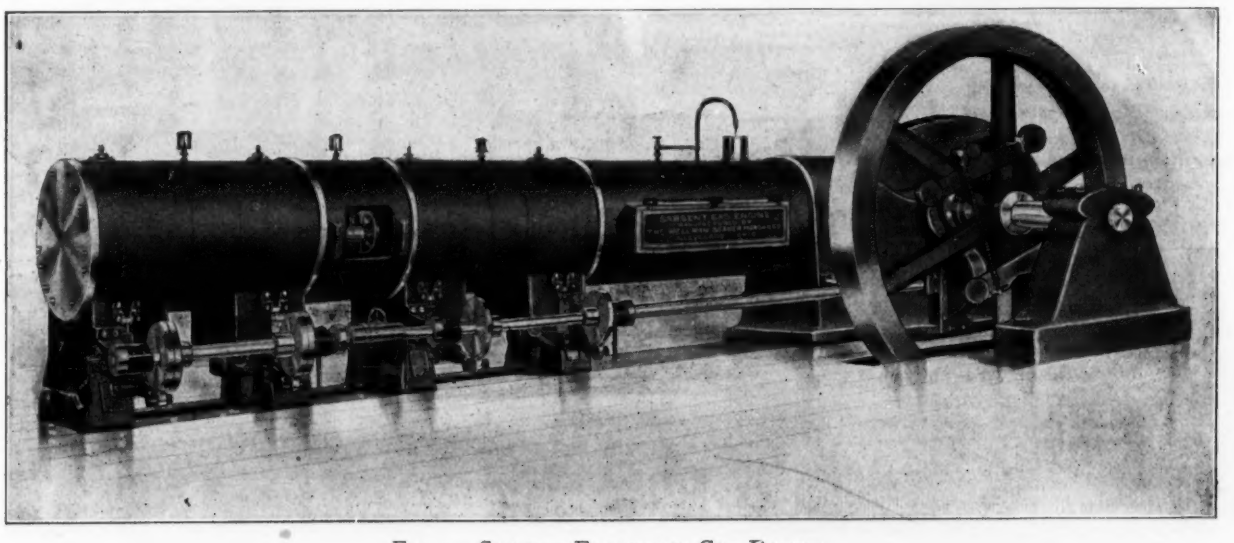


FIG. 1.—SARGENT EXPANSION GAS ENGINE.

The general design, as shown in Fig. 1, is such that all the strains come in a straight line, yet the free expansion of the cylinders and rods is provided for. The sub-base, the top of which comes flush with the floor line, extends from end to end of the engine, thereby giving a flat planed surface upon which the engine is easily erected and aligned. The sub-base and main frame are bolted to the foundation, and the crosshead guides, cylinders and distance head, which fasten to the main frame, can come and go as the temperature varies, sliding on hollow supports rising from sub-base, which not only maintain the cylinders in line, but convey the gas and air from the hollow divided sub-base to the expansion chambers, thus doing away with pipes ordinarily so unsightly and in the way.

The crank, connecting rod, crosshead and guides, while enclosed to keep dirt out and oil in, are accessible even while the engine is in operation, and a steady stream of oil can be seen at all times flowing upon every bearing, not only insuring perfect lubrication, but carrying the heat away, allowing overloading without injury to bearings or rubbing parts.

In the ordinary gas engine, the piston at full load draws in a cylinder full of combustible mixture, which, after compression and ignition, is expanded to the original volume and released at a pressure of 40 to 50 pounds absolute, and a temperature of from 1,500° to 1,800° F. In the Sargent gas engine the admission of gas and air at full load is cut off from five-eighths to three-quarters of the admission stroke, depending on the fuel used, which after compression and ignition, is expanded to the cylinder and is released a little above atmospheric pressure with a corresponding temperature of about 400° F.

The point of cut-off, while constant for the full and most economical load of the engine, is made earlier by the governor as the load gets lighter, or later as the load gets heavier, giving a flexibility unobtainable in the ordinary internal combustion engine.

No throttling action of the incoming charge, with corresponding loss of efficiency in the case of the ordinary gas engine, is possible, and owing to the more complete expansion of the burning gases turning the heat into work instead of throwing it away in the exhaust, a lower terminal temperature and consequently a lower average temperature of the cylinders is maintained throughout the cycle. For this reason engines of this type below 100 hp require no water-cooled pistons or rods.

The mechanism of the Sargent gas engine is particularly simple. A side shaft driven by the crank shaft and governor through a pair of worm gears running in oil, carrying two cams for each explosion chamber, one for the igniter and one to operate the valve, comprises all the moving mechanism except the valves and lever, as shown in Fig. 1, the other side of the engine being perfectly plain.

Fig. 2 shows a section through the valves of one of the explosion chambers. By removing six nuts, the valve bushing and valves can be removed from the cylinder for regrinding or inspection.

Gas is piped to the chamber, *A*, in the sub-base and air to the chamber, *B*, which pass through the cylinder supports to the chambers, *A'* and *B'*, ready to pass into the mixing chamber when the cam depression, *M N*, passes the roller and the ports, *F*, in the piston valve register with the ports *E* and *D* in the bushing. When the piston valve goes down to this position, the confined air in the piston valve dash-pot forces open the poppet valve, thus giving free admission to the charge. When the point *N* of the cam reaches the roller it is forced down, while the other end of the lever goes up, carrying the piston valve which cuts off the admission. The poppet valve seats and both valves remain in normal position during compression, ignition and expansion or until the point *L* on the cam pushes the roller down and the piston up, which opens the poppet and the exhaust gases pass out through the ports *K* and the elbow, *W*, to the exhaust pipe under the floor.

The poppet valve seals the opening in the combustion chamber during compression and inflammation and the piston valve holding

against no pressure, works loosely in its bushing, cutting off the admission and guiding the exhaust. As the poppet valve controls both the inlet and outlet gases, both the valve and seat keep cool and need to be ground not over once or twice a year. The mechanism is simple and as the roller is always bearing on the cam the valve motion is practically noiseless.

By revolving the piston valve by the index wheel, the blind port, *S*, varies the mixture to suit the gas whether it has 100 or 1,000 B.T.U. per cubic foot.

The speed of the Sargent engine is controlled by the well-known Rites inertia governor in the fly-wheel, which advances the valve shaft in time ahead of the crank shaft, as the speed increases, thus diminishing the mean effective pressure with the load. As the load gets lighter, the cut-off becomes earlier, taking less of a constant mixture of gas and air into the cylinder, but as the burnt products in the clearance do not get less, the mixture gets weaker and slower burning. If the ignition were at the same point as at full load, as is the case in the ordinary gas engine, the highest pressure would not be obtained till the piston approached the middle of the stroke, where the cooling surface is so increased that the greater part of the heat goes into the water jacket rather than into the work. In the Sargent engine, the time of ignition advances with the cut-off, getting earlier as the mixture gets weaker, thus maintaining the highest pressure at the beginning of the stroke, irrespective of the load.

While the governor controls the speed through all ranges of load, the gas engine like the steam engine is not economical with

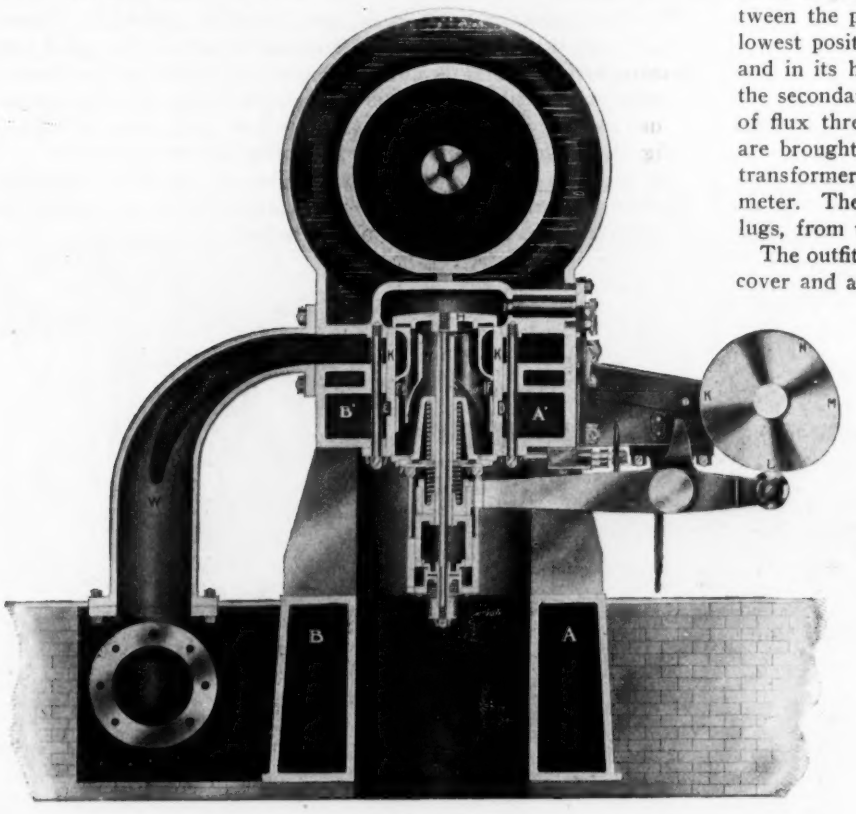


FIG. 2.—VALVE SECTION.

very light loads. Where a variation in the turning moment is not objectionable, one or more of the explosion chambers may be cut out at will by the engineer by simply raising to horizontal position a controlling lever, which holds the exhaust open and the gas and air closed. This is very desirable in blowing engines, as they can be designed so that two explosion chambers will furnish air at 15 pounds and the four chambers at 30 pounds pressure.

If at full load the Sargent engine is cutting off at three-quarters stroke, an overload may be taken care of by a later cut-off, though at a decrease of efficiency.

The cylinders are oiled by a force feed pump or check valve lubricators. The valve gets sufficient oil from the cylinders. The side shaft and out bearings are self-oiling. The cross-head guides, pin crank, pin and main bearings, which must be thoroughly lubricated at all times, are copiously oiled by the worm gears which act as a pump.

Two electric igniters are placed in each explosion chamber in such a position that they are surrounded with a pure mixture at the time of ignition. Either will fire the charge, and should either become short-circuited the engineer is immediately advised.

The engine is started by compressed air. The pressure of the air when turned on at one cylinder puts the starting mechanism into operation and at the same time puts the cylinder out of service as a gas engine. When the engine is up to speed, turning off the air puts the gas engine into commission without changing a valve, cam or lever. Every part of cylinder walls, heads, piston rod and piston is thoroughly water-jacketed to prevent over-heating. Every valve, lever, timing screw and part requiring adjustment, is readily accessible. All mechanism is above the floor line, yet below the center line of engine. Every explosion chamber is accessible by simply removing the cylinder head, which can be done without further dismantling the engine. The time of ignition of the ratio of the gas and air may be changed while the engine is in operation. The Sargent gas engine is manufactured by the Wellman-Seaver-Morgan Company, Cleveland, Ohio.

Transformer for Thawing Out Pipes.

A transformer for thawing out frozen water pipes has been developed by the General Electric Company. The transformer core has three horizontal legs with a closed magnetic circuit at the ends. Flat pancake coils are threaded on the middle leg and spaced apart so as to permit an adjustable flux shunt to move up and down between the primary and secondary coils. When the shunt is in the lowest position, it shunts the primary flux from the secondary coil, and in its highest position permits practically all the flux to thread the secondary coil. At intermediate positions proportionate amounts of flux thread the secondary coils. The leads of the primary coil are brought out to a suitable connection board, on the side of the transformer, on which are mounted primary switches, fuses and ammeter. The terminals of the secondary coil are brought out to heavy lugs, from which cables can be run to the pipes to be thawed.

The outfit complete, including the transformer shown, the switches, cover and ammeter, weighs approximately 1,200 pounds. If desired

TRANSFORMER FOR THAWING OUT PIPES.

it may be mounted on four broad flanged wheels to permit its being quickly loaded on a wagon bed or sleigh. The transformer is light, compact, easy to handle and operate, is self-contained and free from oil, and readily lends itself to adjustments from zero to maximum secondary capacity without wasting energy in a dead resistance. The large radiating surfaces of the core and coils and spacious air ducts insure cool operation under normal conditions.

While the secondary coil is rated at 75 volts and 400 amp., a much larger current is available for temporary operation, especially in winter time. For instance, in starting up with the transformer cold on a winter's day, it will be perfectly safe to take out 800 amp. for ten to fifteen minutes. Smaller currents can be taken out for correspondingly longer periods. The transformer has been especially designed to meet all conditions which may ordinarily arise in practice. It can be applied successively from one operation to another with only sufficient intermission to transfer the connections, and can be used on any pipes of ordinary size and length not requiring an output

more than equivalent to a continuous output of 30 kw or an intermittent output of 60 kw.

The weight is very small considering the capacity. The manufacturer offers smaller and lighter outfits where the conditions warrant their use.

Hancock Valves.

A leaky or defective valve is an irritating annoyance to an engineer, and from his standpoint extraordinary care should be exercised in the selection of material and perfection of workmanship in the making of this appliance. The Hancock Inspirator Company, of 85 Liberty Street, New York, has recognized these conditions and claims that its line of globe, angle and cross valves, both screwed and flanged, are so constructed to meet all of the weak points that practice has disclosed in these types of fittings.

These valves are made of special composition, giving great strength and resistance to wear, and under actual test the bodies of all valves will stand a pressure of 4,000 pounds per square inch without breaking, are tight with a water pressure of more than 1,000 pounds per square inch, and are guaranteed for 500 pounds steam pressure.

In order that the valve seat may be hard and durable, the body is made of a specially hard and tough mixture. The discs are made

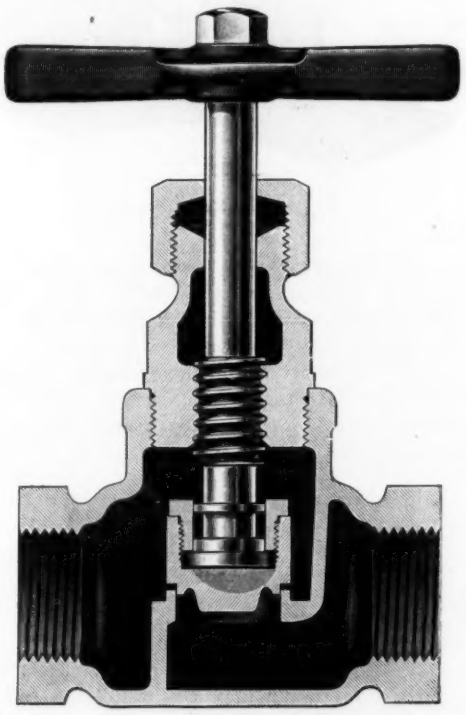


FIG. 1.—SECTIONAL VIEW OF GLOBE VALVE.

of a special mixture which does not contain any zinc. The spindles are all made of Tobin bronze, experience having demonstrated that such a spindle working in a special composition bonnet, will not cut under the highest steam pressures. Referring to Figs. 1 and 2, showing a 1-in. globe valve, it will be seen that the area of the most contracted part of the valve is ample. Two collars on the stem guide the disc nut, thereby compelling the disc to always seat squarely and preventing cocking. The flat valve seat employed has many advantages over any other form used in valves of this character. The valve disc has a projection on it which serves two purposes. In the first place, it acts as a guide when the seat is ground. In the second place, this lip or projection on the disc prevents the cutting of the seat by the wire drawing of the steam when the valve is only slightly open, while when the valve is slightly raised from its seat, as shown in the illustration, with the lip entering slightly, it allows the escaping steam to clean the seat, so that when the valve is seated all dirt and foreign matter have been washed or blown completely off the seat. As a consequence, when a valve begins to leak it requires a very little regrinding to make it tight.

The bonnets of the valves are made with a long thread engaging the body of the valve and the shoulder on the bonnet is made narrow, by which means it is possible to keep the bonnet tight, and moreover the bonnet is easily unscrewed. When it is necessary to regrind the valve to its seat, the bonnet is removed, the disc nut unscrewed from the disc and a piece of wood inserted in the disc, the projection on the disc rendering it unnecessary to have any special regrinding tools for this purpose. All valves are equipped with a tee handle. The

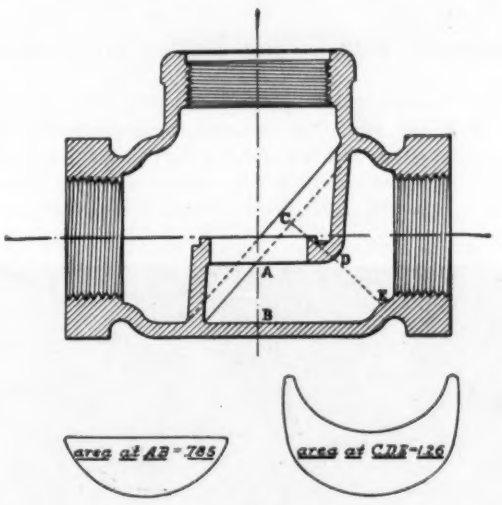
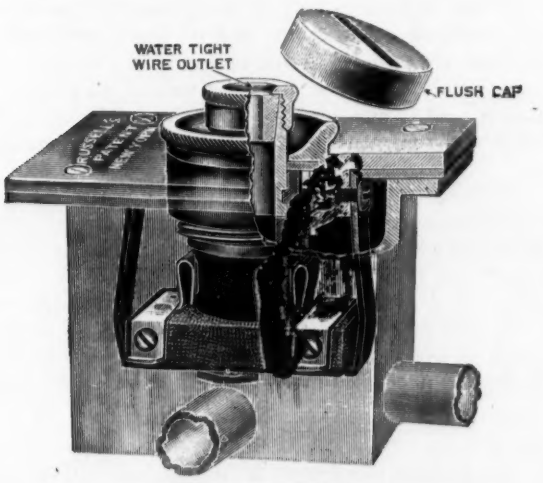


FIG. 2.—DETAILS OF VALVE.

hole in the handle, as well as the valve spindle, are made tapering with one side flattened, the tee handle being held on the spindle by means of a nut. The flattened side holds the handle rigidly in its place, and the taper enables the handle to be drawn tightly to the spindle, avoiding the great annoyance of handles or wheels working loose when attached by the old means of a square only.

Water-Tight Floor Receptacle and Plug.

A new application of marine fittings is shown in the accompanying illustration. The union nut carried by the plug holds the plug securely in place in the box, and at the same time makes a water-tight joint about the neck of the plug by means of the gasket. The smaller nut on top of the plug is a means for drawing a soft rubber cork into the taper neck of the plug to make a water-tight joint around the cable leading from the plug. This, it will be seen, not only



FLOOR RECEPTACLE.

cushions the cable outlet, but prevents foreign matter or moisture from entering the plug. When the plug is removed a small flush cap, carrying a gasket on the inner side, is used to establish a water-tight surface to the box.

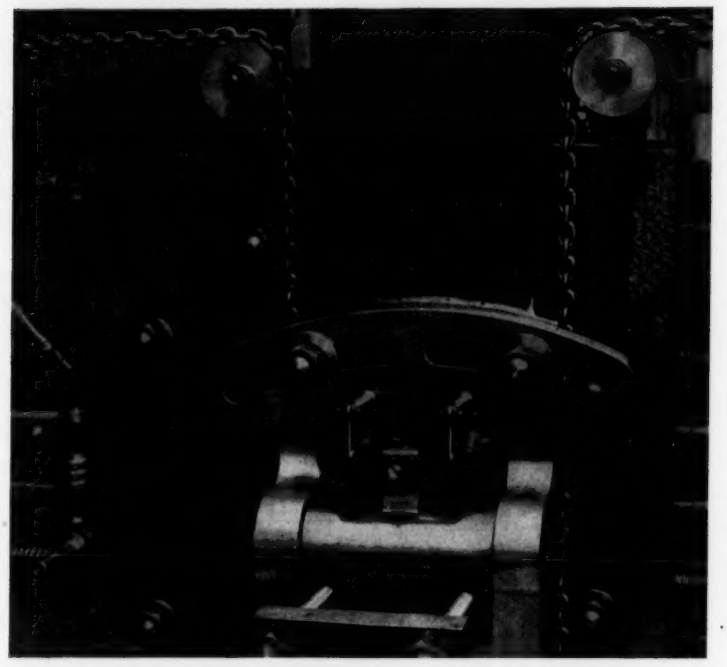
The plug top has a standard ½-in. pipe thread which readily admits of mounting an extension piece where required. It can be inserted in one way only, which insures the proper polarity connections, and the contact springs are of such shape as to secure permanent adjustability. These fittings are extremely compact, and have

been designed to meet the general needs of floor outlets and easy installation.

Russell & Stoll Co., 48 Cliff Street, New York, the manufacturer, makes a specialty of water-tight receptacles, and a general line of marine lighting equipment.

Magnetic Tool-Lifting Device for Planers.

This device is attached to planers for the purpose of lifting the tool away from the cut at the end of the cutting stroke, so as to avoid all undue wear and grinding away of the back of the tool. It consists of an electromagnet and armature. The magnet is fastened to the clapper box, while the armature is suspended by means



MAGNETIC TOOL-LIFTING DEVICE.

of a pair of small links directly in front of the magnet, and straddling a tail of the tool apron. The magnet attracts its armature at the proper moment and forces the armature against the tail of the tool box, thus lowering this tail, and raising the free end of the tool box.

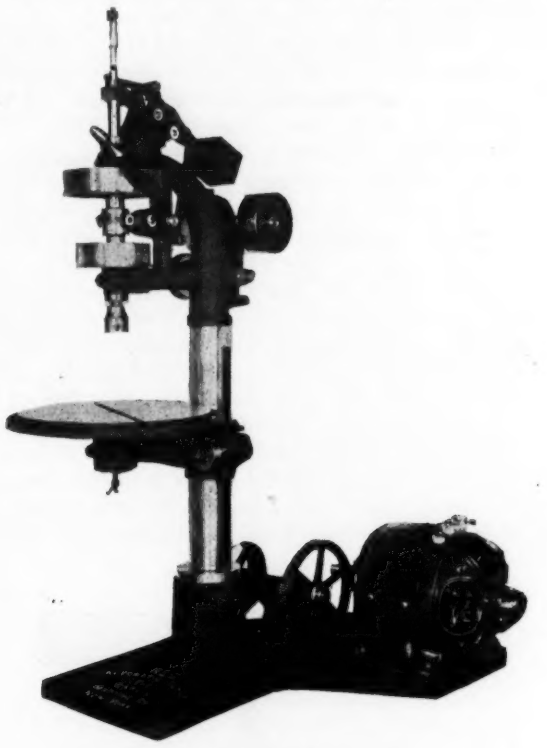
This action takes place exactly at the moment of reversing. The armature is released again at the end of the return stroke. The timing is absolutely perfect, so that no extra long stroke is required when using this device. It acts equally well at all positions of the rail or saddles and at any angle of the swing. The energizing current is led into the magnet by lamp cord suspended from the top of the planer.

A set-screw regulates the amount of relief given to the tool, from nothing up to its maximum. The operation of a small switch will throw the device out of action, if so desired. The device does not interfere with the ordinary working of the tool apron. The apron can be lifted up for renewal of tools, etc., without disturbing any part of the tool-lifting device. Direct current is necessary, of course; 110 volts are preferable, but 220 or 500 volts can be used. This apparatus is being furnished by the Niles-Bement-Pond Machine Co.

Automatic Tapper With Motor Drive.

The Garvin Machine Company, of New York, is now fitting its No. 2 automatic tapper with motor drive, in the manner shown in the accompanying illustration. A variable-speed motor having a range of 900 to 1,800 r.p.m. is used, geared down by spur gear and pinion to drive the pulley at the base, which is then belted up to the spindle in the regular way. The variable speed of the motor serves the function of a cone pulley and no change gearing is needed. But one belt is used to drive both forward and reverse pulleys on the spindle, this being accomplished by looping the belt around the idlers.

A bevel friction, operated by toggle, plays between the friction pulleys on the spindle. The spindle is operated by the lever on the side. The same movement throws in the friction clutch and a

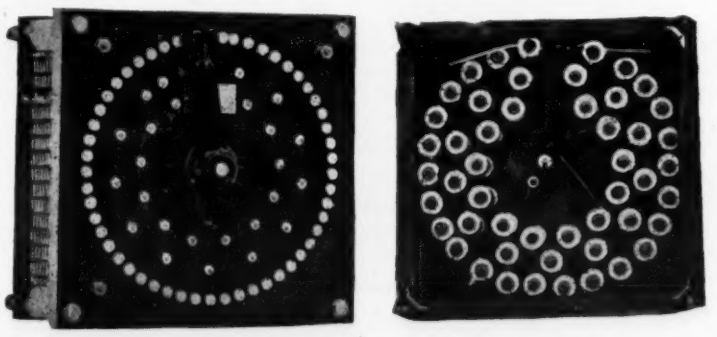


MOTOR-DRIVEN TAPPER.

latch holds it in. As the spindle feeds down an adjustable collar on the spindle trips the latch and the friction clutch flies over into the reverse pulley. The reverse is independent of the pressure on the lever. The friction can be adjusted very closely to suit the tap, so that the friction will slip and avoid breaking the tap, no safety device is needed, and the automatic trip secures uniformity in working. The machine can be arranged to operate by treadle, or two heads can be mounted on one column.

Booster Field Rheostat.

The Ward Leonard Electric Company, Bronxville, N. Y., by using its enameled resistance units and mounting them as shown in the cut, has been able to produce a booster field rheostat which will occupy very little space and which will fulfill the following specifications: Rheostats to operate on 150-volt circuit having one side



BOOSTER FIELD RHEOSTAT.

grounded. To have 50 steps. Total resistance, 250 ohms. Capacity tapered from 4.9 to .6. The resistance of each step to be not more than 10 per cent. lower or 10 per cent. higher than the value specified by the generator manufacturer who desires to give the resistance per step. Temperature rise not to exceed 200° F. Approximate dimensions to be 12 x 12 in. face and 8 in. deep.

The adaptability of standard resistance units each used as a step is perfect for such special rheostats.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Holiday inactivity prevailed in the stock market, prices showing moderate strength in the later fluctuations. Some importance was attached to prospective legislation at Washington as to Government control of railroads and corporations, but the undertone of the market was, in the main, strong, in anticipation of investment demands after January 1. One of the most prominent incidents of the week was the declaration of the initial dividend of 1½ per cent. on Reading common, after more than a quarter of a century. There was little activity in any of the standard stocks despite a continued discussion of the probabilities of a Northern Securities settlement. United States Steel shares were quieter. Amalgamated Copper continued to be a leading feature and developed very irregular tendencies, mainly of a manipulative origin. Traction and electric securities were irregular, comparatively little business being done in them. Brooklyn Rapid Transit closed at 60⅛, a net gain of ⅜-point; and Metropolitan Street Railway at 120, ex-div., a gain of 1¼. Allis-Chalmers closed at 16, a net loss of one point; General Electric 185, a loss of 1½ points, and Westinghouse common 180½, a net loss of 3 points. Westinghouse preferred made a fractional net gain, closing at 195. In the telegraph group Western Union is ½-point off, closing at 92¼, ex-div.; American Telephone & Telegraph lost 1½ points, the closing price being 146½, while American Telegraph & Cable, closing at 93½, made a net gain of 1¼ points. In the curb market transactions were small and prices tended downward. Liquidation was most prominent in the copper group. Following are the closing quotations of December 27:

NEW YORK

	Dec. 20	Dec. 27		Dec. 20	Dec. 27
Allis-Chalmers Co.	16⅛	15⅝	Electric Vehicle	16	14⅝
Allis-Chalmers Co. pfd.	64	60	Electric Vehicle pfd.	21	21
American Tel. & Cable.	93	92	General Electric.	185⅛	186
American Tel. & Tel.	146	147	Hudson River Tel.	..	..
American Dist. Tel.	..	..	Interborough Rap. Tran.	163⅜	164
Brooklyn Rapid Transit.	60⅝	61	Metropolitan St. Ry.	121⅛	120⅝
Commercial Cable.	..	..	N. Y. & N. J Tel.	..	166
Electric Boat	38	37	Marconi Tel.	..	..
Electric Boat pfd.	72	72	Western Union Tel.	92¾	92
Electric Lead Reduction.	⅛	⅛	Westinghouse com.	182¼	180
			Westinghouse pfd	190	110

BOSTON

	Dec. 20	Dec. 27		Dec. 20	Dec. 27
American Tel. & Tel.	146	147¼	Western Tel. & Tel. pfd.	99	100
Cumberland Telephone.	120	120	Mexican Telephone.	1¾	1¾
Edison Elec. Illum.	253	254	New England Telephone.	136	137
General Electric.	185	185	Mass. Elec. Ry.	14	13¼
Western Tel. & Tel.	*20	20	Mass. Elec Ry. pfd.	58¾	57½

PHILADELPHIA

	Dec. 20	Dec. 27		Dec. 20	Dec. 27
American Railways.	48	48	Phila. Traction.	98⅝	98¼
Elec. Storage Battery.	79	77	Phila. Electric.	10½	10⅜
Elec. Storage Battery pfd.	79	77	Phila. Rapid Trans.	17¾	17⅝
Elec. Co. of America.	10¼	10¾			

CHICAGO

	Dec. 20	Dec. 27		Dec. 20	Dec. 27
Central Union Tel.	..	..	National Carbon pfd.	110	..
Chicago Edison.	..	170	Metropolitan Elev. com.	22⅛	22
Chicago City Ry.	181	..	Union Traction.	9¾	..
Chicago Tel. Co.	145	145	Union Traction pfd.	38½	39
National Carbon.	43	45			

* Asked.

CONNECTICUT RAILWAY & LIGHTING REPORT.—The subjoined gives figures of the annual report of the Connecticut Railway & Lighting Company for the year ended June 30:

	1904.	1903.	1902.
Gross	$1,248,670	$1,048,259	$1,106,868
Expenses	844,105	819,091	668,454
Net	$404,565	$229,168	$438,414
Other income	177,490	180,374	167,953
Total income	$582,055	$409,542	$606,367
Charges, tax, etc.	536,207	527,905	518,553
Surplus	$45,848	*$118,363	$87,814

*Deficit.

The following is the balance sheet of the Connecticut Railway & Lighting Company as of October 1, 1904:

Assets:	
Construction and equipment	$28,772,340
Other permanent investments:	
Roton Point (property and lease)	133,905
Current assets:	
Cash	80,515
Bills receivable	2,400
Accounts receivable	65,922
Material and supplies	113,538
Prepaid accounts	23,069
Reconstruction account	34,189
Total assets	$29,225,870
Liabilities:	
Preferred stock	$5,752,500
Common stock	9,247,500
Funded debt	11,904,682
Current liabilities	232,707
Taxes accrued	24,175
Interest on funded debt accrued	134,274
Miscellaneous interest accrued	3,164
Rentals accrued	1,247
Advance ticket sales	2,826
Deposit accounts	3,267
Insurance fund	14,217
Stock conversion	1,752,500
Surplus	152,811
Total liabilities	$29,225,870

TRACTION ON THE PACIFIC.—Mr. H. E. Huntington, president of the Pacific Electric Railway Company, has arrived in New York from Los Angeles. He and Mr. E. H. Harriman have purchased the outside interests in the Los Angeles electric railway lines and are in control of the properties. With them is associated J. W. Hellman, one of the most prominent capitalists in California. The three properties are the Los Angeles Railway Company, the Los Angeles Interurban Railway Company, and the Pacific Electric Railway Company. Mr. Harriman is associated with Mr. Huntington in the last two. The Huntington lines already comprise 400 miles of track and extensions are constantly under construction. A line is now under construction from Santa Anna to connect with the Los Angeles Long Beach line at Watts. The interurban service is of the highest order. The express run from Los Angeles to Long Beach, 22 miles, is made in 27 minutes. The local trains on the same line, stopping at every station, make the run in 45 minutes. A power house on the Kern River, which will have a minimum output of 10,000 h.p., is nearing construction. The current will be 60,000 volts a distance of 125 miles.

CHICAGO TROLLEY SITUATION.—A special dispatch from Chicago of December 19 says: "A scramble for traction shares almost obscured the trading in Industrials on the Chicago Stock Exchange to-day and resulted in an advance of 9 points in West Chicago Street Railway. North Chicago certificates advanced from 82 to 87½. It has been known for a week that there is a warm contest on for proxies of these companies, particularly for West Chicago. Negotiations for the private purchase of the stocks are said to have been going on in San Francisco and New York as well as in Chicago. The warring interests in the North and West Chicago street car companies will, it said, in future present a solid front in the fight for the extermination of the Union Traction Company."

TROY UNITED TRACTION.—The United Traction Company, chartered in 1899, and now controlling all the street railway business in the cities of Albany, Troy Cohoes, Watervliet, Lansingburg, Rensselaer, Green Island and Waterford, N. Y. for the year ending June 30, 1904, reports gross earnings of $1,704,758 and the net earnings of the company are more than double the fixed charges; in fact, the net earnings for the six months ending November 30, 1904, show an increase of over 26 per cent. in excess of the net earnings for the corresponding period of 1903. N. W. Harris & Co. are offering to investors $900,000 United Traction Company consolidated mortgage 100-year 4½ per cent. bonds.

CONNECTICUT RAILWAY AND LIGHT BONDS.—An additional $2,558,000 first and refunding mortgage four and one-half per cent. bonds, due 1951, of the Connecticut Railway & Lighting Company, making the total amount listed to date $10,913,000. The committee further recommends that there shall be two calls for the bonds, namely: Connecticut Railway & Lighting Company first and refunding mortgage four and one-half per cent. bonds of 1951, and Connecticut Railway & Lighting Company first and refunding mortgage four and one-half per cent. bonds of 1951, stamped "Guaranteed."

KANSAS CITY COMPANY LOAN.—The Kansas City Railway & Light Company has effected a loan of $3,000,000 for three years at 5 per cent., through Kuhn, Loeb & Co. and Blair & Co., with the privilege of calling the notes after one year at 100 and interest. The notes are secured by $2,000,000 of the company's bonds and $2,500,000 of the preferred stock.

BUFFALO BELL TELEPHONE.—The Bell Telephone Company, of Buffalo, has offered stockholders of record at close of business on December 24, 1904, $550,000 new stock at par, $100 a share. The right to subscribe expires January 14, 1905, and payment is due February 14, 1905. On June 30, 1903, the American Telegraph & Telephone Company owned $2,762,700 of the capital stock.

CHICAGO TUNNEL SCHEME.—The Chicago Subway Company, owned and controlled by large railroad and financial interests, has made announcement that among the prominent men in the directory of the Illinois Tunnel Company, the operating company, will be the following: A. J. Earling, president of the Chicago, Milwaukee & St. Paul; E. P. Ripley, president of the Atchison, Topeka & Santa Fé; George B. Harris, president of the Chicago, Burlington & Quincy; S. M. Felton, president of the Chicago & Alton; J. Kruttschnitt, Director of Maintenance and Way, Southern Pacific & Union Pacific; B. L. Winchell, president of the Rock Island; A. C. Bird, vice-president of the Gould lines; F. D. Underwood, president of the Erie; Benjamin Thomas, president of the Chicago & Western Indiana; P. A. Valentine, vice-president of Armour & Company, and Albert G. Wheeler, president of the Illinois Tunnel Company. Announcement of the representatives of other railroad interests in the tunnel company's board will be made in a few days. Among the additional directors will be representatives of the Vanderbilt lines, the Pennsylvania Railway and the Chicago & Northwestern Railway. The Chicago Subway Company owns the stock of the Illinois Tunnel Company, the Illinois Telephone Construction Company, and the Chicago Warehouse & Terminal Company. The tunnel company will operate the tunnels constructed in Chicago for the transfer of all freight, merchandise, mail, newspapers and packages between business houses and the railway stations. The Illinois Telephone Construction Company will also enter into contracts for excavations and deliver building material for new buildings through the tunnels.

DIVIDENDS.—Detroit United Railway Company's directors have declared the regular quarterly dividend of 1 per cent., payable February 1. Directors of the Central & South American Telegraph Company have declared the regular dividend of 1½ per cent., payable January 6. Rochester Railway directors have declared a dividend of 1¼ per cent. on the preferred stock, payable January 3. Hall Signal directors have declared the regular quarterly dividend of 1½ per cent. on the common stock, payable January 3. Directors of Mexican Telegraph have declared the regular quarterly dividend of 2½ per cent., payable January 13. American Telegraph & Telephone directors have declared the regular quarterly dividend of 1½ per cent. and ¾ per cent. extra. The directors of the International Power Company have declared a dividend on the preferred stock of $3 per share, payable on March 1, 1905. The Cincinnati Gas & Electric Company has declared a regular quarterly dividend of 1¼ per cent. The Boston Elevated Railway Company, lessee, has declared a regular semi-annual dividend of $2 on the preferred stock of the West End Street Railway Company, payable January 2. United Traction Company of Pittsburg directors have declared a dividend of 2½ per cent on the preferred stock, payable January 20. semi-annual dividend of 50 cents, payable January 2. The directors of the Columbus Gas Light & Heating Company have declared a dividend of 3 per cent. on the preferred stock, payable January 15. Consolidated Traction of New Jersey directors have declared a dividend of 1½ per cent., payable January 15.

CENTRAL & SOUTH AMERICAN TELEGRAPH.—The December 31 quarter (partly estimated) is reported as follows:

	1904.	1903.	1902.	1901.
Gross	$301,500	$286,500	$265,000	$257,000
Expenses	94,500	97,000	93,500	99,500
Net	$207,000	$189,500	$171,500	$157,500
Other income	.....	5,300	5,000	3,500
Total income	$207,000	$194,800	$176,500	$161,000
Dividends	115,884	115,884	115,884	115,884
Surplus	$91,116	$78,916	$60,616	$45,116
Previous surplus	979,521	805,651	714,962	586,858
Total surplus	$1,070,637	$884,567	$775,578	$631,974

TROLLEY MERGER.—The State Railroad Commissioners has authorized the consolidation of the Worcester and Southbridge, the Southbridge and Sturbridge and Worcester, Rochdale and Charlton Depot Street Railway companies, the controlling interest in all of which has been acquired by the New York, New Haven and Hartford Railroad. The new system, to be known as the Worcester and Southbridge Street Railway Company, received permission to increase its capital stock by $100,000, to be used in purchasing the outstanding stock of the Southbridge and Sturbridge and Charlton Depot roads, on a share for share basis.

W. H. GOUGH ELECTRIC COMPANY.—A petition in bankruptcy has been filed against the W. H. Gough Electric Company, of Syracuse, N. Y., by the E. G. Wyckoff Company, the Davis Electric Manufacturing Company, of New York, and the J. H. White Manufacturing Company. Nominal assets, $11,000, and liabilities, $15,000.

NEW BRUNSWICK LIGHTING.—The Public Service Corporation of New Jersey will, as already announced, lease the plant of the New Brunswick Heat & Power Company for 900 years, paying a rental equal to a dividend of 2 per cent. on the latter's stock during 1905 and 1906, 2½ per cent. for the next two years, 3½ per cent. for the next two years, 4 per cent. for the next year, and 5 per cent. for the next and each succeeding year.

NEW ORLEANS TROLLEYS.—The plan for reorganizing of the New Orleans Railways Company calls for the reducing of the capital from $80,000,000 to $60,000,000 and an assessment of $20 per share on the preferred and $10 per share on the common stock.

Commercial Intelligence.

THE WEEK IN TRADE.—The demand for holiday goods exceeds expectations, but trade in seasonable goods is quiet. Business conditions are satisfactory, however, manufacturing plants producing freely, except where insufficient water supply restricts operations. Reports as to trade in the leading cities are encouraging. Transportation is in enormous volume and exceeds car capacity in some industries, notably bituminous coal. Railway earnings (gross) are up to the best of the year and exceed those of all previous corresponding periods. Net returns indicate present profitable operation about making up for lessened earnings earlier in the year. Production of iron and steel is close to full capacity, except where interrupted by local conditions of coke and car supply, but evidently fails to meet consumptive inquiry, which is large and insistent for pig iron, structural material, bars, plates, bolts and a variety of less important products, all of which are higher in price. Reports as to orders booked by the United States Steel Corporation point to the largest volume of unfilled orders on hand ever reported at this period of any year. Southern retail trade is of good volume, but some effect from holding cotton is noticeable in demand and collections. The copper market is dull and prices are nominal. Lake was quoted at the close at 14⅞ to 15⅛c.; electrolytic, 14¾ to 15c.; casting stock, 14½ to 14¾c. Domestic consumers are buying very little of the metal. *Bradstreet's* reports the number of business failures for the week ending December 22 as 249, against 239 the week previous and 243 the corresponding week of last year.

IMPORTANT ELECTRIC RAILWAY CONTRACTS.—The Rochester, Syracuse & Eastern Railroad Company, which proposes to build a line from Rochester to Syracuse, N. Y., has just given out contracts for equipment. There will be a main power house, located at Lyons, and three sub-stations. The electrical equipment for these plants will be furnished by the Westinghouse Electric & Manufacturing Company. The Westinghouse Company will also equip all the rolling stock, and will supply the air brake apparatus. The contract amounts to about $300,000. The principal power units will be two turbo-generators. The cars are to be equipped with four motors, each of 110-hp, and geared for about 60 m. p. h. The multiple-unit system of control has been adopted. The contract for cars has not yet been awarded, nor has the contract for track and overhead material. The contract for track and overhead material will not be given out until February. The section of road between Rochester and Lyons, a distance of 37 miles, will be the first to be fitted out.

ELECTRICAL MANUFACTURERS' EXPORT COMPANY.—The Electrical Manufacturers' Export Company was recently incorporated, under the laws of the State of New York, with a nominal capital of $10,000 for the purpose of acting as a foreign sales department of the Stanley Electric Manufacturing Company, of Pittsfield, Mass.; the Northern Electrical Manufacturing Company, of Madison, Wis.; the General Incandescent Arc Lamp Company, of New York City; the Fort Wayne (Ind.) Electric Works, and the Sprague Electric Company, of New York City. The president of the company is Mr. M. D. Barr, second vice-president of the Stanley Company; Mr. Hunting, of the Fort Wayne concern, is vice-president; Mr. D. C. Durland, treasurer of the Sprague Company, acts in the same capacity for the new concern, while Mr. H. I. Skilton, of the Stanley Company, is general manager. The new offices of the company are in the Columbia Building, 29 Broadway.

POWER FOR MEXICAN REDUCTION WORKS.—The construction of a large hydraulic plant is contemplated by the Amparo Mining Company, which controls extensive mining property in the State of Jalisco, Mexico. It is proposed to utilize the waters of the Magistral River. The State Government has the application for the necessary concession under consideration. The Amparo people intend to use the electric current to operate their big reduction works principally. Mr. Ferdinand Sustersic, of the city of Guadalajara, is manager of the company.

EQUIPMENT FOR CERRO DE PASCO MINES.—The Cerro de Pasco Mining Company, which is conducting very extensive copper mining operations in Peru and in which Mr. J. B. Haggin is

primarily interested, is buying substantial quantities of electrical equipment in this market for installation on its property. Considerable Westinghouse machinery is being put in and a 60-ton electric traveling crane, also a 10-ton outfit built by the Alliance (O.) Machine Company will be installed.

POWER IN TENNESSEE.—Mr. John Bogart has returned to New York after spending several days along the Tennessee River making investigations concerning the proposed development of water power there for the city of Chattanooga. He spent several days going over the river at the request of Messrs. E. C. James and J. C. Guild, to whom the city of Chattanooga has given the rights to build a dam twenty miles below the city. By this scheme, authorized by act of Congress, the builders will go ahead with the $2,000,000 task by which a dam thirty-five feet high will be constructed. "All of my investigations, which were conducted in conjunction with officers of the United States Engineer Corps, convinced me that the plan to develop power and to render the river navigable is entirely feasible and can be carried on with good profit," said Mr. Bogart. "In the first place, the construction of the dam will give the Tennessee River a depth of from thirty-five feet at the dam ranging to a minimum depth of five feet at the city of Chattanooga. This is against a depth of from five feet down to two feet at the present time. Although the dam is twenty miles down the river from the city of Chattanooga, wires from the dam to the city would only have to run six miles across country to take the generated power back to the city for use, and as forty-eight new manufacturing industries have sprung up in Chattanooga in the last twelve months, all desiring cheap power, the profit on the investment would be sufficient at the outset to pay all the fixed charges of the company." Mr. Bogart went to Tennessee to make the investigation through the law firm of Brown & Wells, who are the local attorneys for the promoters of the enterprise.

HOLYOKE LIGHTING PLANT BIDS.—The bids for the engines, generators and turbines called for by the gas and electric light departments, which were opened recently, have been more closely inspected, but no decision will be reached for several days. The engine bids are as follows: D. S. Mackintosh Company, $17,175; Shepard Engine Company, $12,520; same company, $11,630; Allis-Chalmers Company, $13,700; Allis-Chalmers Company, engine and generator, $19,465; Buckeye Company, $12,100; Robert Witherell & Company, $11,950; Brown, Corliss Company, $10,000; same company, engine and generator, $16,400. Turbines, General Electric Company, $18,000; Westinghouse Company, $18,750. Generators, General Electric Company, $6,270; Westinghouse Company, $8,762; Fort Wayne, $6,315; Crocker & Wheeler Company, $5,907; same company, $6,535; Bullock Electric Company, $5,610. Boilers, Robert Witherell & Company, $10,560; Edward Kendall & Son, $5,749; Bigelow Company, $5,961; Holyoke Steam Boiler & Iron Works, $6,600. The bids on their face do not clearly indicate the difference in the offers from the different companies. The machinery proposed is of larger capacity in some instances than others. Mayor Chapin and Manager Snow will determine which bid, all things considered, offers the best advantage to the city. The municipal plant charges the city $100 per year per arc, not full arcs.

WILKESBARRE PLANTS CONSOLIDATE.—The Wilkesbarre Gas & Electric Company was incorporated under the laws of the State of Pennsylvania last week, with a capital stock of $1,500,000 for the purpose of taking over the properties of the Gas Company, of Luzerne County, Pa., which supplies gas to Wilkesbarre; the Wyoming Valley Electric Light, Heat & Power Company, which furnishes electric light and power in the same territory and the Ashley Electric Light Company, which concern recently secured a franchise to enter Wilkesbarre. Additional electrical equipment will be installed in the existing plant at Wilkesbarre. A 750-hp turbo-generator will be ordered. In all, fully a quarter of a million dollars will be spent in various improvements. Primarily interested in the company are J. G. White & Company, of 49 Exchange Place. They will award the contracts for the new equipment, etc.

WALLA WALLA POWER.—A special dispatch from Walla Walla says: "The work of finishing the power house of the Washington & Oregon Power Company's big plant on the Walla Walla River, near Milton, is in progress. The flume is complete, and only the power house is to be finished before the current will be ready. Although the work will be finished in December power will not be conducted along the lines until the first of the year. Gasoline engines are being used to pump water from the river into the pipe. This also completes the siphon system. Between Pendleton and Adams workmen are putting the glass insulators on the poles and fastening the wires. In Athena and Weston an immense amount of wiring is being done, as nearly everyone is putting in power or lights. The plant will develop 10,000 horsepower.

AIR BRAKES FOR CLEVELAND TROLLEYS.—A number of the larger cities, such as Philadelphia, Buffalo and Detroit have all their cars equipped with air brakes, same being installed as new and larger cars were purchased, but it remained for the Cleveland Electric to place the largest contract for the individual air brake compressors that has ever been placed in this country. The decision was not arrived at until after over two years' of experimenting. The National Electric Company, of Milwaukee, Wis., was awarded the contract last week, and is arranging to ship several carloads of air brakes, which will be installed under the new convertible type of cars of the Cleveland Electric Railway immediately.

TROLLEY NETWORK FOR OHIO.—An alliance of traction interests from Cincinnati, Indianapolis, Toledo, Cleveland and Philadelphia is being completed that will give to western Ohio and eastern Indiana the most important, far reaching and comprehensive system of suburban lines in the world. The main spirits of the undertaking are the Elkins-Widener traction interests of Philadelphia, represented by W. Kelsey Schoenf, manager of the company's lines in Cincinnati, and Hugh J. McGowan, manager of the company's lines at Indianapolis and through that part of Indiana. The plans call for through lines from all the large cities represented, and will bring hundreds of miles of traction under one management and in one system.

POWER AT DULUTH.—Tucker, Anthony & Company, of Boston, and Charles D. Barney & Company, of New York and Philadelphia, announce that they have formed a syndicate to supply the money for the development of the water power in the St. Louis River, between the cities of Duluth and West Superior. It is proposed to develop something over 100,000 hp. The first installation will be for 30,000 hp and will be completed in about eighteen months. Work will be started immediately.

PHILADELPHIA CONDUITS.—The sub-committee of the Councils electrical committee has reported negatively the Commonwealth Electric Company's ordinance, giving it permission to lay wires in the Keystone Telephone Company's conduits. The electrical committee of Councils adopted resolutions to report to Councils with a negative recommendation the Commonwealth Electric Company ordinance, and asking to be relieved of further consideration of the subject.

ZEPAYANTLA PLANT TO BE ADDED TO.—The Compania Molino de la Union S. A. is the name of a company organized under the Mexican laws for the purpose of operating the electric power plant at Zepayantla, and working the Molino de Union flour mills electrically. The capital stock of the company is $1,000,000. Mr. Albert Henkel is the president of the enterprise. The headquarters of the company are in Toluca. The Zepayantla plant will be enlarged.

NATIONAL ELECTRIC COMPANY.—One of the largest contracts ever taken by the National Electric Company, of Milwaukee, Wis., has been closed with the Street Railway Company, at Cleveland, O. The contract calls for 700 air brakes and complete equipments to be used on the street cars of that city. The estimated cost is in the neighborhood of $280,000.

DRAWBACK ON SWITCHBOARDS.—The Treasury Department has directed that on the exportation of electric switchboards, manufactured by the Western Electric Company, with the use of imported starting resisting boxes, a drawback may be allowed equal to the duty paid on the imported starting resisting boxes less the legal deduction of 1 per cent.

CANADIAN WESTINGHOUSE.—The Canadian Westinghouse Company's nine new buildings, in the city of Hamilton, Ont., have been completed, and within a few weeks some 1,000 skilled mechanics will be occupying them. The company has begun to install the new machinery already, which will take a short time to complete.

EQUIPMENT FOR NEW HARLEM HOSPITAL.—Orders are expected to be let shortly for equipment to be put in the power house at the New Harlem Hospital on Lenox Avenue, between 136th and 137th Street. Pattison Bros., Flat Iron Building, are the electrical engineers.

PLANT FOR NEW APARTMENT HOTEL.—A large apartment hotel is to be constructed at Fifty-seventh Street and Broadway by the Fifty-seventh Street & Broadway Company. A good-sized electric light and power plant will be put down in the building.

MORE EQUIPMENT FOR SAN LUIS POTOSI.—It is proposed to install considerable additional machinery in the plant of the Potosina Electric Company, which concern lights the city of San Luis Potosi, Mexico.

LIGHTING PLANT FOR TIERRA NUEVA.—An electric lighting plant is to be installed in Tierra Nueva, district of Santa Maria del Rio, State of San Luis Potosi, Mexico. Señor Escontria, the Governor of the State, has already granted the necessary franchise.

TURBINES AT PITTSFIELD.—Rumors are persistently afloat at Pittsfield, Mass., that the General Electric Company will build Curtis turbines at the Stanley works.

General News.

THE TELEPHONE.

LOS ANGELES, CAL.—The Richardson Construction Company has been formed to build telephone lines in Mexico. Capital, $500,000. The organizers are Davis Richardson and L. R. Richardson.

MIAMI, FLA.—The Miami Telephone Company has been organized with Glen C. Frissell, president, and H. C. McCowan, secretary.

CHESTER, ILL.—The Harrisonville Telephone Company intends to improve its system here in order to retain its franchise.

EDWARDSVILLE, ILL.—The franchise granted to the Fosterburg and Upper Alton Main Line Telephone & Telegraph Company has been accepted.

CANTON, ILL.—The Canton Home Telephone Company will commence the construction of a line to Fiatt as soon as the material can be placed upon the ground.

MARENGO, ILL.—The Farmers' New Era Telephone Company, now operating in Hebron and Alden townships, has petitioned for right of way privilege along the highways of Chemung, Alden, Hebron, Richmond, Burton, Hartland, Greenwood, Dorr and McHenry townships, in said county, for 99 years.

WATERLOO, ILL.—The Farmers' Fountain Telephone Company was organized here Dec. 22, and will soon begin the work of constructing three lines of 20 telephones each. The farmers will construct the line and share in the expenses prorata. The cost of maintenance will also be proprated. The central exchange for all these lines will be at New Hanover. It is probable that the lines will be extended throughout Monroe County, should the system prove successful.

MATHERS CHAPEL, IND.—A telephone company is being organized here by John Sanders.

AMBOY, IND.—The Amboy Home Telephone Company has increased its capital stock from $2500 to $5000, with a view of making improvements and extensions. Noah W. King is president and W. H. Myers, secretary.

UNIONDALE, IND.—The Uniondale Rural Telephone Company has increased its capital stock in the sum of $11,700 for the purpose of making improvements and extensions. V. M. Hatfield is president and J. L. McBride, secretary.

LIBERTY, IND.—The Liberty Telephone Company has incorporated, capitalized at $20,000. The principal office and exchange will be in Liberty. W. A. Bryson, Daniel Rosier, B. M| Grove, C. S. Mitchell, James Allen and others are the promoters.

LEBANON, IND.—Mayor Ross has vetoed the ordinance granting a franchise to the Central Union Telephone Company to do a local business in this city. His objection to the ordinance was that it failed to stipulate at what price the company proposed to furnish telephones or telephone service. A new ordinance providing for stipulated rates will now be introduced.

FRANKLIN, IND.—The Central Union Telephone Company is asking for a franchise to do a local business here. The Franklin Telephone Company has 800 telephones in operation, is giving good service and free connection with seven other independent companies. A dual system is generally opposed by the people and the ordinance is meeting with opposition.

LA GRANGE, IND.—The stockholders of the Northern Indiana & Southern Michigan Telephone Company have elected the following officers: Frank J. Smith, president; Charles Sears, vice-president; J. Frank Roop, secretary; Alice Ellison, treasurer. There has been a considerable extension of the lines, mainly in Michigan. The company now serves a territory extending from 12 miles west of Constantine to Waterloo, and from Orland to the Hawpatch.

MILL CREEK, I. T.—At a meeting of the City Council it was decided to grant a franchise for a telephone company to operate within the city limits.

MOULTON, IA.—The Farmers' Mutual Telephone Company has been voted a franchise.

CENTERVILLE, IA.—The Mutual Telephone Company is considering improvements and extensions to its plant.

KEOKUK, IA.—Fire has destroyed the Bell Telephone Exchange and damaged the Western Union Telegraph office of Keokuk.

WATERLOO, IA.—The Warren Township Company has been organized. August Nolf is president; W. Wendt, vice-president, and Emil Walther, secretary.

NEW LIBERTY, IA.—The Farmers' Mutual Telephone line between Sunbury and New Liberty, has been organized and the line will be ready for operation as soon as material can be had and the line completed.

CUBA, KAN.—There is talk of constructing a new telephone line between Cuba and Belleville.

BEVERLY, KAN.—The Beverly Telephone Company has been incorporated with a capital stock of $3000.

KIRWIN, KAN.—The Mutual Telephone Company has been incorporated with a capital stock of $1500.

WEBER, KAN.—The Weber Telephone Company has been incorporated with a capital stock of $5000.

OXFORD, KAN.—The Oxford Mutual Telephone Company, of Oxford, has been formed; capital, $3000.

LEWIS, KAN.—The Edwards County Telephone Company has been incorporated with a capital stock of $5000.

PARALLEL, KAN.—The Riley County Farmers' Telephone Company has been incorporated with a capital stock of $2600.

WELLINGTON, KAN.—R. W. Kemp, contracting engineer of Wichita, Kan., has just completed an exchange for the Farmers' Mutual Telephone Company at South Haven, and has secured the contracts to build the mutual lines for the Chickaskia Mutual Telephone Company from Milan to Wellington, via Mayfield and the Oxford Mutual Telephone Company from Oxford to Wellington, via Dalton. The lines, when complete, will connect with the Farmers' Mutual Company at Wellington and make a mutual system of over 2000 subscribers.

ANTHONY, KAN.—The Southwestern Telephone Company, which has offices in this city has recently built a new exchange at Enid, Okla. The Southwestern Company owns 7 exchanges in the State of Kansas and in Oklahoma Territory, all of which are prosperous. The company has an annual income of over $50,000, and has paid dividends steadily during the eight years of its existence. The officers are: President, P. G. Walton; vice-president, F. R. Zacharias; secretary and treasurer, Fred Washburn.

COVINGTON, LA.—It has been definitely announced that H. H. Smith, Paul Laborde and several other prominent citizens of this place will organize a telephone company and put in an up-to-date local exchange.

NEW BRUNSWICK, MASS.—The Richibusto Rexton Telephone Company has been formed; capital $20,000. The incorporators are A. C. Carsonm, Richard O'Leary and others.

LANSING, MICH.—The Mason & Okemos Telephone Company has been formed with a capital stock of $2500.

FLINT, MICH.—The Michigan State Telephone Company has just closed an important deal in this county in the purchase of the rural telephone system established several years ago by Dr. W. H. Taylor, of Clio, with which about 30 farm residences in that vicinity are now connected. Steps will be taken at once to extend and generally improve the newly acquired system.

BENTON HARBOR, MICH.—Much dissatisfaction has been caused among telephone patrons in this city and St. Joseph by the announcement that telephone rates on the lines of the Michigan Telephone Company and the Twin City Telephone Company will be raised from $18 to $30 per year January. There is even some talk of organizing an independent telephone company here. The Michigan Company and the Twin City Company have an agreement whereby the former gets the absolute right to do business in St. Joseph and the latter gets the same privilege in this city.

PELICAN RAPIDS, MINN.—The Pelican Rapids Telephone Company intends to erect new lines to Altoona, via Lida and Spirit Lake, to Audubon.

ROCHESTER, MINN.—The Tri-State Telephone Company has been granted a franchise for a toll line connection in this city.

CYRUS, MINN.—Business men here have organized a local telephone company. H. C. Estby is president, Carl Steensland, secretary.

ECHO, MINN.—Business men here are interested in a proposition to build a rural telephone line from Echo to join the Redwood County system at some point on the county line north of Vesta.

WHITE EARTH, MINN.—Indian Agent Michelet is securing estimates of cost for the construction of a telephone line to the Mahnomen, Beaulieu and Porterville government schools.

READING, MINN.—The Farmers' Mutual Telephone Company has been incorporated with a capital stock of $25,000. The company has installed a number of lines and proposes to connect with every town in the county.

ST. PETER, MINN.—The committee representing the stockholders of the Nicollet County Telephone & Telegraph Company has completed the purchase of the St. Peter system. The deal will make the Nicollet County Company one of the largest independent concerns in Minnesota, as it will operate exchanges at St. Peter, Kasota, New Sweden, Gibbon, Gaylord and Lafayette, together with 175 miles of country lines.

MINNEAPOLIS, MINN.—A syndicate of local capitalists has purchased the properties of the Mississippi Valley Telephone Company, of Iowa, which operates five large exchanges, covering the territory about Muscatine, Burlington, Keokuk, Fort Madison and Wapello. The purchase price was $400,000. It is the intention of the owners, headed by S. S. Thorpe, to spend money liberally in improving the present lines. All of the plants will be put in first-class shape, it being stated that about $200,000 will be employed in increasing the efficiency of the exchanges and in constructing new lines. The name of the old concern will be retained by the new management. The system was organized by J. C. Hubinger, of Keokuk.

HIGGINSVILLE, MO.—Sixty farmers have organized a new telephone company and will build 30 miles of line from Higginsville to Salem.

BELLEVILLE, MO.—The Rural Telephone & Telegraph Company, which was incorporated at Belleville recently, plans to erect telephone lines throughout St. Clair County. Belleville men are at the head of the movement, and they state that the line will be in operation over the entire county inside of a few months. The capital stock of the company is $2500, and the incorporators are Albert Hucke, L. D. Turner and George Detharding.

FREMONT, NEB.—The Fremont Telephone Company is contemplating extending its line to Ponocco.

BEATRICE, NEB.—The Independent Telephone Company will build another line to Blue Springs as soon as possible.

VENTNOR CITY, N. J.—The City Council has passed an ordinance granting the Atlantic Coast Telephone Company the right to erect poles and string wires in the streets of the city for telephone service.

JOHNSONVILLE, N. Y.—The Johnsonville Telephone Company has been incorporated with a capital stock of $500. The directors of the company are L. D. Van Wirt, C. I. Haner, C. H. Abbott, C. M. Herrington, C. E. Akin, H. Sherman and E. D. Herrington.

BISMARCK, N. D.—The Interstate Electric & Telephone Company has been granted a local franchise.

PARK RIVER, N. D.—Henry Wilson, of Wimbledon, has purchased the city telephone exchange from Nixon & Oglesby.

BISMARCK, N. D.—The Mandam & Northwestern Telephone Company will extend its lines to Center, Oliver County, next spring.

MOORHEAD, N. D.—At a special meeting of the Moorhead City Council the franchise which was granted to the Tri-State Telephone Company recently was rejected. This will necessitate the building of a line around the cities of Fargo and Moorhead. The line is already built from the Twin Cities to Moorhead and from Fargo north to Grand Forks, and the franchises in this city and Moorhead were to have completed the connections.

COLUMBUS, OHIO.—The Peoples' Telephone Company, of Chester Hill, has increased its capital stock from $5000 to $15,000.

IRONTON, OHIO.—Work on the new telephone line of the Southern Bell system, from Ceredo to Wayne, will be started at once. Another line will be started by the same interest from Wayne to Effie in the near future.

URBANA, OHIO.—The Bell telephone has inaugurated a new rate of toll services for night which is considerably lower than formerly and also lower than the other company charges. For instance, it cost 25 cents to talk to Dayton and now the service costs only 15 cents. Cincinnati can be reached for 30 cents, formerly 55 cents. Bellefontaine rate is cut in two and is now only 10 cents. All this provided the talker talks at night.

BYRON, OKLA.—The business men and farmers around Byron have organized a mutual telephone company to build an exchange and rural lines.

CLEVELAND, OKLA.—Cleveland's telephone system has been sold by a local company to G. M. Coddington, formerly of Holton, Kan.

WAKITA, OKLA.—A charter has been issued to the Grand Valley Co-operative Telephone Company to be located at Wakita, with a capital stock of $2000. Incorporators: P. R. Smith, Wm. Barr and L. D. Jones, all of Wakita.

PLAIN GROVE, PA.—The Plain Grove Telephone Company has been formed with $5000 capital.

HARRISBURG, PA.—The Hollenbach Telephone Company has been incorporated. Capital $5000.

BENTLEYVILLE, PA.—The Maple Creek Telephone Company, a branch of the Federal, is getting rights of way to extend its lines into town.

PAXVILLE, S. C.—The Sumter telephone line is being extended from here to Summerton.

GAFFNEY, S. C.—The Cherokee Telephone Company has been permanently organized at Gaffney, with T. G. McCraw, president; J. V. Whelchel, vice-president, and J. E. Jefferies, secretary.

ELK POINT, S. D.—W. W. Main is preparing to build a telephone line to Spink at once.

EDEN, S. D.—The Aberdeen Telephone Company will build a line from Sisseton to Eden.

YANKTON, S. D.—The new independent long-distance telephone company is constructing a line from here to Sioux Falls.

MARION, S. D.—The Marion Telephone Company, capital $10,000, has been formed. The incorporators are Jacob Hieb, president; Dr. A. E. Hofer and others.

HUNTINGDON, TENN.—A new telephone company has been organized in some of the lower counties with a capital stock of $50,000. It will be known as the Consolidated Telephone & Telegraph Company, and is made up of the Sloan Telephone Company, of Linden; the Savannah Telephone Company, the Clifton Company and the Tennessee River Telephone Company. The incorporators are: President and manager, W. N. Hughes; vice-president, T. S. Hughes; secretary, J. F. Barlow, and treasurer, J. K. Barlow. The company will operate lines in Perry, Lewis, Decatur, Wayne, Hardin and McNairy counties. Lines will also be run to Corinth, Miss., and to Florence, Ala.

HOUSTON, TEX.—The Southwestern Telegraph & Telephone Company will construct a long-distance line from Houston to Humble.

GALVESTON, TEX.—The Southwestern Telegraph & Telephone Company is installing a new central energy system, and work has been commenced on the stringing of 50,000 feet of lead cable. The laying of the new cables will complete the work in Galveston and place all the wires in the business district in cables. The Galveston exchange is growing at the rate of 300 new subscribers a year, and its directory now numbers 2185 subscribers.

OGDEN, UTAH.—The Rocky Mountain Bell Telephone Company's exchange in this city will be enlarged and a new switchboard will be installed at a cost of $35,000.

SEATTLE, WASH.—The Independent Telephone Company has been granted a fifty-year franchise to operate in King County. The company intends to extend its business across Lake Washington to Kirkland, and from there make connections with all the small towns within a radius of 40 miles, as soon as it is found that the places have a pressing and urgent need for a telephone service. In addition, the long distance lines are being extended toward Tacoma with the idea of entering that city just as soon as a franchise is secured and the people signify a desire to have the independent company establish an exchange in Pierce County.

PARKERSBURG, W. VA.—The Mountain State Telephone Company has been chartered, capital $10,000. The incorporators are R. S. Moore, E. Browne and others.

HUDSON, WIS.—The Hudson Prairie Telephone Company has been incorporated.

FOX LAKE, WIS.—The Wisconsin Telephone Company will construct a toll line between Fox Lake and Portage.

WINNIPEG, MAN.—Petitions have been presented to the Legislature asking for incorporation of the Independent Telephone Company, of Canada. Promoters of the company are residents of Minneapolis and they have fixed their capital stock at $10,000,000 and estimate it will cost them $2,000,000 to install the service in Winnipeg.

ELECTRIC LIGHT AND POWER.

SYRCEY, ARK.—The Black Hawk Electric Company, Davenport, Ia., has recently secured the contract to install a complete municipal electric lighting plant, inluding all equipment and involving an outlay of about $20,000, at Syrcey, Ark.

WILLIMANTIC, CONN.—At a Board of Trade meeting the question was raised of utilizing the water power at the Natchang pumping station for generating electricity for lighting the streets of the city.

NEW CANAAN, CONN.—The Berkshire Power Company, of North Canaan, has been incorporated by Walter S. Morton and Arthur D. Newton, of Hartford, and J. Henry Roraback, of North Canaan, with a capital of $250,000.

DANBURY, CONN.—There has been presented a petition of the Danbury Power Company to the General Assembly for a charter to establish a power plant on the Still River at Brookfield and New Milford, and to transmit electricity from the plant to Danbury, Bethel, Brookfield, Ridgefield and Redding. The men making the petition are Charles H. Merritt, S. C. Holley, M. H. Griffing, B. A. Hough and A. N. Wildman.

LAGRANGE, GA.—Bids are wanted Dec. 31 for $25,000 electric light bonds. T. J. Hartwell is city clerk.

MOLINE, ILL.—The Peoples' Power Company, of Moline, has increased its capital from $600,000 to $1,000,000. Extensive improvements are contemplated.

MACKINAW, ILL.—The Mackinaw Electric Light Company has been incorporated with a capital of $8000. Incorporators: S. A. Thompson, Geo. Tyrrell and C. G. Sparks.

BELLEVILLE, ILL.—The Ada Electric & Gas Company ,of Belleville, has been incorporated with a capital of $100,000. Incorporators: J. A. Hamilton, A. B. Daab and L. D. Turner, Jr.

MATTHEWS, IND.—The Matthews Electric Light & Power Company has been incorporated, capital $15,000. Directors: Guy S. Rinebolt and Everett W. North.

DUNKIRK, IND.—The Dunkirk Lighting Company, of Dunkirk, has been incorporated; capital $21,000. Directors: Chas. A. Harkins, Chas. O. Reynolds and Jesse M. Soper.

TERRE HAUTE, IND.—The Board of Public Works has decided to recommend to the City Council the bid of the Terre Haute Traction Company for lighting the streets for 5 years on an all-night schedule, at $75 a lamp per year.

FAIRFIELD, IA.—The Fairfield City Council has entered into a contract with the Western Electric Company, of Chicago, for a new lighting plant to be installed in this city as soon after the first of the year as possible. There will be 75 lamps, each one being of 2000 candle power. The price of the new plant will be $2735, including a new Corliss engine of 125 horse-power, manufactured by the Murray Iron Works, of Burlington, the cost of which is $1500.

ELLSWORTH, ME.—The electric lighting system here is to be remodeled and several improvements are in contemplation.

BANGOR, ME.—At a meeting of the City Council orders were passed looking to increase of the city's electric lighting plant, and for inquiry into the proposition for the city to generate light, power and heat for sale.

GREENEVILLE, ME.—A fire which at one time threatened the entire village caused at total loss of about $50,000, of which there is an insurance of $30,000. The Moosehead Power Company's plant was burned to the ground.

BRIGHTWOOD, MASS.—Manufacturing industries at Brightwood are interested in a movement for a combination to install a power plant in that vicinity to furnish the factories with light and power.

FALL RIVER, MASS.—The Fall River Electric Light Company has purchased a wharf from D. M. Anthony. Eventually the Electric Light Company will establish its main generating plant there. At the present location of the company's plant there is no further room for extension except at a comparative increase in the cost of operation. By establishing a plant at the shore the company will be able to save in several directions, and increase its capacity with a comparative reduction in cost.

CITY OF MEXICO, MEX.—Major George B. Burbank and George Stuart Simons, of New York City; A. S. Harvey, of Leaville, Col., and Philadelphia capitalists are interested in a project to establish a great electric light and power plant at the Malinaltango Falls, near the City of Mexico. About 25,000 horse-power will be generated.

NEW MEXICO, N. MEX.—Col. J. C. Bonner and others, of Toledo, have formed a company to develop water power in New Mexico. The company expects to furnish electric light and current to Los Vegas, Sante Fe and Albuquerque. Work on the plant is to begin in the near future.

MONROE, MICH.—Ground has been broken for an electric lighting plant for the new St. Mary's Academy building, now being erected in this city. The power house will be 150 x 60 feet, with modern equipment and will cost $60,000.

DETROIT, MICH.—The Edison Illuminating Company announces that it will discontinue the use of steam at its plant on Washington Avenue, and use motor-driven generators, taking power from the Detroit Edison plant in Delray for that purpose.

MINNEAPOLIS, MINN.—The Gas Committee of the Council has approved the bids of the General Electric Company for arc lights, of the Minneapolis Gas Company for gas, and the Patterson Street Lighting Company of Cleveland, Ohio, for installing and maintaining incandescent gas lamps. All the arc lights will be put upon an all-night schedule. The specifications call for

an annual service of 150 hours longer than that of last year. The cost of the lamps remains the same as last year under the shorter schedule, $94 per lamp per year. All the 5500 gas lights in the city will be equipped with the incandescent mantle, and the old-time open flame burner will also become a provincial memory of the streets of Minneapolis. The Patterson Company will maintain these 5500 lights for $23.40 per light per year. There are 2600 incandescent lights now in the city and 2900 open flame lights. The increased cost to the city on gas lights for next year will amount to something over $14,000. Gas will be furnished by the Minneapolis Gas Company at the present rate, 95 cents per 1000 cubic feet.

ST. LOUIS, MO.—The contract for furnishing light and power at the World's Fair grounds during the entire post-exposition period has been awarded to the Union Electric Light & Power Company of St. Louis. The plant which formerly furnished power to the Exposition will be removed within a few days. Director of Works Taylor announced that there will be 400 arc lights in service on the grounds, with thousands of incandescents.

NORTH HAMPTON, N. H.—Several citizens at North Hampton Centre have begun negotiations with the Rockingham Light & Power Company, regarding the installation of a system of electric lighting in their neighborhood. The plan is meeting with decided approval.

TRENTON, N. J.—The Michigan Light Company has been incorporated with a capital stock of $2,250,000 to construct and operate heating and lighting plants. The New Jersey office it at Jersey City. The incorporators are Walter B. Mahoney, Walter Thiele and Charles N. King, all of Jersey City.

JERSEY CITY, N. J.—The stockholders of the recently incorporated North Jersey Electric Light, Heat & Power Company, which rumor says may be a competitor of the Public Service Corporation, has elected directors and officers at the office of John J. Treacey, in Jersey City. Thomas J. Maloney was elected president, Michael T. Connolly, vice-president, and County Superintendent Christopher P. Smith, secretary and treasurer. Other directors are William J. Dynan and Charles Wagner. Mr. Maloney is president of the Continental Tobacco Company. Mr. Connolly and Mr. Wagner are contractors in Jersey City, and Mr. Dynan is a tax assessor in Hoboken and the publisher of the Hoboken Observer. John J. Treacey, counsel to the company, said that it had not been formed to antagonize any other corporation, and was independent of all other electric light companies. He said that it expected to begin operations in the spring in the territory in which electric lighting was practically undeveloped.

LOCKPORT, N. Y.—It is stated that the Niagara, Lockport & Ontario Power Company, which has just increased its capital stock from $1,000,000 to $10,000,000, will build a $100,000 transformer house at Lockport.

NIAGARA FALLS, N. Y.—The Buffalo & Niagara Falls Electric Light & Power Company may soon have competition. The street committee of the Common Council has under consideration four proposals for franchises. The petitioners are the Niagara Falls Gas & Electric Light Company, the Ontario Power & Transmission Company, the Niagara County Home Telephone Company and the Niagara, Lockport & Ontario Power Company.

MURPHY, N. C.—The Murphy Electric Light & Power Company, of Murphy, has been chartered with a paid-in capital of $6000. The incorporators are A. J. Gentry, S. W. Lovingood, R. V. Swain and others.

HAMILTON, OHIO.—The ordinance granting a franchise to the Hamilton Heating & Power Company has been passed. The company made a concession by inserting in the ordinance an amendment to pay into the city treasury one per cent. per annum of its gross receipts, and also obligated itself not to furnish electric light or electric power to consumers so long as the city electric light plant was in existence.

RED LION, PA.—The Red Lion Electric Light Company has been sold to George Heisey, of Lancaster, for $11,740.

DEADWOOD, S. D.—The Black Hills Electric Light Company has been granted a new franchise by the City Council. The city has reserved the right to buy the plant at any time.

LYNDON, VT.—C. C. Edwards has sold his interest in the electric light plant to Arthur Hunt, Roscoe Renfrew and Wm. Guthrie. At the recent meeting of the stockholders H. A. Gilfillan, John A. Buffum, W. H. Burbank, S. Moore, W. H. Morrison, Jerry Abbott and Arthur Hunt were elected directors. The directors elected Arthur Hunt, manager; W. H. Burbank, treasurer, and Wm. Morrison, collector.

REARDON, WASH.—J. M. McDowell has applied for an electric lighting franchise and will order machinery at once. He expects to have the plant in operation March 1.

WALLA WALLA, WASH.—The plant of the Washington & Oregon Power Company on the Walla Walla River it is expected will be in operation by the first of the year. The plant will develop 10,000 horse-power and will furnish power and lights in the various towns of this part of the two states.

PROSSER, WASH.—The Prosser Falls Land & Irrigation Company is considering the building of an electric railway from Prosser to Sunnyside. The company is now awaiting a decision of the Supreme Court of the state, which will determine whether it can have an electric light franchise in this town.

LA CROSSE, WIS.—A new independent lighting company, capitalized at $200,000, is seeking a franchise here. Henry A. Salzer and other business men of La Crosse are large stockholders.

LACROSSE, WIS.—The Wisconsin Light & Power Company, a new corporation capitalized at $200,000, has applied for a franchise in this city. The incorporators are J. J. Hogan, G. Van Steenwyk, Henry A. Salzer, John C. Burns and George Schweizer.

THE ELECTRIC RAILWAY.

BIRMINGHAM, ALA.—A. H. Ford, G. H. Davis and C. F. Ubelacher, of the firm of Ford, Bacon and Davis, of New York, have recently visited Birmingham, to confer with the Birmingham Railway, Light & Power Company relative to the expenditure of about $1,000,000 in improvements and extensions.

DENVER, COL.—The Denver, Cliffside & Boulder is the title of the new railroad company that is to be incorporated by residents of Boulder and vicinity. They will construct the road and it will be operated under a lease by the Denver City Tramway Company. The Tramway Company will furnish the power. The officers of the Denver, Cliffside & Boulder are L. C. Stockton, president; James Outram, treasurer; E. M. Pruden, Cliffside, secretary, and W. S. Lee.

COLUMBIA CITY, IND.—The Huntington, Columbia City & Northern Railway Company, with a working capital of $25,000, has been organized to build an electric railway from Huntington to South Bend. A. H. Weist, Jr., of the Portland, Montpelier & Huntington line, is the general manager.

LEBANON. IND.—The Lebanon-Thornton Traction Company has been organized and incorporated with a capital stock of $150,000 by Frank M. Reed, H. M. Atkinson, Robert P. Woods, Indianapolis; A. C. Daily, Empson T. Lane, S. M. Ralston, Richard Neptune, Lebanon, Ind.; W. C. Jacques, R. E. Niven, L. C. Riley, R. S. Stall, W. C. Burk, Wm. Emmons, W. O. McKern and Ezekiel R. Jacques, Thorntown, Ind.

NILES, MICH.—Articles of incorporation have been filed by the Niles & Buchanan Railway Company, which was receently organized with a capital stock of $25,000 for the purpose of building an electric railway between the two towns.

SEDALIA, MO.—The Sedalia City Council has granted a franchise to the Sedalia & Warrensburg Interurban Electric Railway to construct and operate a railway through the city. The line is to be built to the new Missouri Pacific shops in East Sedalia, through the city to Warrensburg, a distance of 30 miles. The company has already secured the right of way and purchased land upon which to erect power and machine houses.

ELIZABETH, N. J.—The Elizabeth & Raritan River Street Railway Company has filed a certificate amending its route through South Amboy.

DERRY, N. H.—A new storage battery is soon to be put in on the line of the Chester & Derry electric road.

ROME, N. Y.—S. C. Baldwin, of Rome, chairman of the committee of the Citizens' League, of Rome, to investigate the matter of building an electric railway from Rome to Boonville, has made a lengthy report favoring the road. The Citizens' League will take action on the report in the near future.

BALLSTON, N. Y.—The Eastern New York Railroad Company, of Ballston, to operate an electric road 10 miles long from Ballston to Middle Grove, Saratoga County, has been incorporated, capital $100,000. Directors: F. F. Barrett, Saratoga; Fred A. Beach, B. S. Cole, Ballston; T. R. Heller, Somerton.

ROCHESTER, N. Y.—It is stated that negotiations are in progress between the Lehigh Valley and the Rochester & Eastern Railway to lay a third rail on the Naples branch of the Lehigh, so that the passenger service may be improved by running the Rochester & Eastern cars to Naples, the southern terminus of the branch; also to connect the tracks of the two roads at Victor for the interchange of freight traffic.

RALEIGH, N. C.—The County Commissioners have granted the franchise asked by the Raleigh and Durham Traction Company. The Raleigh Chamber of Commerce has endorsed the proposition to build this proposed 28 mile electric railway.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway proposes making $250,000 in improvements the coming year.

HANOVER, PA.—The York County Traction Company has secured a controlling interest in the Hanover & Littlestown Turnpike Company, and will extend its Hanover line to Littlestown in the spring.

LANCASTER, PA.—At a meeting at Conestoga Centre two routes for the proposed electric railway to connect with the line to Lancaster were considered. Sentiment favored a line from Safe Harbor to Conestoga Center, thence to New Danville and Engleside, a distance of over 10 miles. This line would connect with the Lancaster line at Engleside. Surveys will shortly be made.

GREENVILLE, PA.—The name of the Greenville Electric Railway Company has been changed to the Shenango Traction Company. The construction of the line from Greenville to West Middlesex will be commenced as soon as franchise ordinances are passed by the Councils of Sharon, South Sharon, Wheatland and West Middlesex. An extension to Conneaut Lake and Meadville, on the north and to New Castle on the south are strong probabilities.

MANNING, S. C.—A movement is on foot backed by business men of Manning and other places, to build an electric railway from Manning through Summerton to Wright's Bluff.

SAN MARCOS, TEX.—The project of building an interurban electric railway between San Marcos and Luling, Tex., has been taken hold of by local and outside capitalists. Judge B. G. Neighbors, of San Marcos, is interested in the project.

BRENHAM, TEX.—A syndicate of St. Louis capitalists propose to build an interurban electric railway between Brenham and La Grange, a distance of about 25 miles. G. A. Heilig and J. F. Wolters, of La Grange, are the active representatives of the St. Louis parties in the enterprise.

CORPUS CHRISTI, TEX.—H. F. McGregor, manager of the Houston Electric Company, and John Tod, of Houston, have been investigating the situation here with the view of constructing an electric street railway system. They are said to represent a syndicate of Eastern capitalists who will undertake the work if their report is favorable.

NEW INDUSTRIAL COMPANIES.

THE DAGGETT TROLLEY EQUIPMENT COMPANY, of Vineland, N. J., has been incorporated with a capital stock of $50,000, by L. E. Heinly and W. F. Daggett.

THE MOTOR CONSTRUCTION COMPANY, of Garwood, N. J., has been incorporated with a capital stock of $50,000. The incorporators are Henri G. Chatain, Gustavus T. Kirby, P. C. Midgley and William B. Elliott.

THE SOUTHWESTERN ELECTRIC COMPANY, of St. Louis, Mo., has filed articles of incorporation with a capital stock of $1500, fully paid. The incorporators are Dudley J. Pine, James C. Knight and David B. Stinson, and Willard Knight.

THE SOUTH SIDE AUTO COMPANY, of St. Louis, Mo., has filed articles of incorporation with a capital stock of $5000, fully paid. The incorporators are Wm. R. Orthwein, Newman Samuel, Louis A. Hoerr, John Hoerr, Jr., and Henry H. Hoerr.

THE NORTHERN COUNTIES CONSTRUCTION COMPANY has been incorporated at Jersey City, N. J., with a capital stock of $35,000. The incorporators are Edwin W. Hammer, Edwin R. Lamson and Joseph Hover. The company is to construct and develop public works, including railroads, docks, piers, wharves, canals, telegraph, telephone and electric light lines and

THE STANDARD BRACKET & PIN COMPANY, has incorporated at Madison, Ind., with a capital stock of $12,000. The company will manufacture and sell arms, brackets and pins, used by telephone and telegraph companies, and other wares. The principal office and manufactory will be in Madison. A. L. Schmidlap, G. W. Coffield, B. T. Head, B. F. Law and Charles Schnailler are the incorporators.

THE KUSEL & KUSEL AUTOMATIC SWITCHBOARD & TELEPHONE MANUFACTURING COMPANY, of Elkhart, Ind., has filed articles of incorporation with the Secretary of State. The capital stock is $10,000. The object of the company is to manufacture, buy and sell automatic switchboards, telephones and other electric devices and supplies and other things in connection with the manufacture of such merchandise. I. J. Kusel, H. J. Kusel, H. C. Randall, E. L. Kersletter and G. W. Brown constitute the board of directors.

OBITUARY.

W. FORMAN COLLINS.

MR. W. FORMAN COLLINS.—We noted with deep regret last week the news, received just as we went to press, of the sudden and entirely unexpected death of Mr. W. Forman Collins, publisher of the *Western Electrician*, at Chicago. He had been down to his office as usual the day before (December 20th) and on waking up on the morning of December 21, told his wife that he had had a good night's rest. Before he was able to arise, however, he lurched forward suddenly into his wife's arms and expired immediately. Apoplexy was the cause of death. Mr. Collins' health had not been satisfactory for years past. He was subject from boyhood to a mysterious ailment something like vertigo which returned at intervals and gave his family and friends much concern. Mr. Collins was born in the County of Suffolk, England, on September 14, 1867. His father was a prominent lawyer, being a Queen's Counsel, but died while Mr. Collins was still a mere boy. Mr. Collins took up electrical engineering as a profession, and after graduating from one of the technical colleges came to this country about 1885, and was for a time connected with the Callender conduit and cable interests. He had considerable inventive ability and did some excellent work on the designing of Waddell-Entz machines, as well as on the armature of one of the best known modern motors. He became connectel with the *Electrical Engineer*, one of the publications since absorbed by the ELECTRICAL WORLD AND ENGINEER, and about 1890 went to Chicago as its representative. In 1892 he bought a large interest in the Electrician Publishing Company, of Chicago, the publisher of *The Western Electrician*, of which he became vice-president and business manager, positions which he retained actively until his death. In 1896-7 he spent about a year abroad for the benefit of his health and was apparently much better for the change; but he was very careful of his mode of living and concentrated his time and attention upon the journal to the exclusion of professional work, in which he was deeply interested. Mr. Collins is survived by a wife, but no children, and leaves three brothers and a sister in England. Outside of business he led a retired and very happy domestic life, going little into society, and taking but a small share in public work, for the better conservation of his health and energies. The funeral services took place on December 23d, at Trinity Church, Chicago, and the interment followed at Albany, N. Y.

MR. J. C. JOHNSON.—The death is announced of Mr. J. C. Johnson, treasurer of the Delaware and Madison Counties Telephone Company of Indiana. The cause was apoplexy and was entirely unexpected, although Mr. Johnson had been sick for a couple of days. Mr. Johnson was president of the leading national bank in Muncie, Ind., and was a man of very large wealth. His age was about 65 years. He was well known in financial and independent telephone circles.

LEGAL.

NEW YORK CITY TRACTION.—The appellate division of the New York Supreme Court has overruled the board of railroad commissioners in refusing to grant permission to the New York City Interborough Railway Company to gridiron the Bronx with a system of tracks which would open communication east and west through the Bronx and north and south in competition with the Union Railway Company. The court decides that leave should be granted to build all but two out of the eight tracks asked for, the two being parallel to the Union Railway Company's tracks. The result leaves six new tracks granted, mostly east and west, and two refused.

CANDLE POWER OF LIGHTS.—The Supreme Court of New Jersey has sustained the Central Electric Company of New Jersey against the Street Lighting District No. 1, of Woodbridge Township, in a litigation over payment because of alleged low candle power. The rulings are: 1. An electric lighting company furnished electric current for street lighting under a written contract. The defense was that the lights were not of the power required by the contract. It appeared that, after the tests upon which the defense relied were made, the defendant paid for the lights furnished up to the ensuing 1st of January at the full contract rate. It did not appear that any objection as to the character of the lights furnished thereafter was made by the defendant; and there was no proof of subsequent tests during the existence of the contract. Two of the three lighting commissioners testified that the contract was satisfactorily performed. Held, that it was error to refuse to charge that the plaintiff could recover under the common courts in assumpsit.

INSPECTION OF LIGHTING APPARATUS.—In May, 1900, a man named Verdon applied to the North Hudson Light, Heat & Power Company to install an electric meter in the saloon of which he was tenant on the corner of Fourteenth and Hudson Streets, in Hoboken, N. J., for the purpose of furnishing him with light. The company contracted with an independent and competent electrician to install the meter, and he did so on June 9, 1900. The company began at once to supply the electric current, and on July 19, 1900, a fire started in the meter box and damaged the saloon, the building in which it was located and several adjoining buildings. An examination made afterward disclosed a probability that the electrician had failed to drive home a small screw to bring the feed wire of the electric current into perfect and steady contact with the binding post of the meter, and that this imperfect connection had permitted the current to produce a spark, which finally caused the conflagration for which action was brought by the Hoboken Land & Improvement Company against the United Electric Company of New Jersey with verdict for plaintiff. The case was appealed. The defendant is the successor and representative of the North Hudson Company. This the claim for compensation rests upon a charge of negligence against the electric company for transmitting its current through the defective apparatus. The Supreme Court of New Jersey has ruled that: "An electric company, before sending its current for lighting purposes through the apparatus installed in a building by other parties, is bound on its own responsibility to make reasonable inspection of the apparatus to see whether it is fit for use."

PERSONAL.

THEODORE P. BAILEY.

MR. THEODORE P. BAILEY, assistant manager of the Western office of the General Electric Company, leaves that company on January 1, 1905, to become vice-president and general manager of the L. E. Myers Company of Chicago. Mr. Bailey has been associated with General Electric interests for more than 20 years, having entered the employ of the Van Depoele Electric Light Company in 1882, soon thereafter becoming secretary of the company. He held this position until 1884, when he became selling agent for arc lighting apparatus of the Thomson-Houston Company in the west. His success in that work made him easily the choice of his company to assume the management of its railway department in the west when it took up that work in 1887. At that time the territory of the Chicago office covered everything in the United States west of Chicago. When the consolidation took place in 1892, and the General Electric Company was formed, Mr. Bailey continued the management of the railway department. In 1890 he read a paper before the Chicago Electrical Club, in which the prediction was made that electricity would eventually supplant the cable as a motive power on street railways. This statement was bitterly attacked at the time by interests controlling cable railways, in the fear that such statements would, if denied, depreciate the value of cable railway stock, and partly no doubt because many street railway men at that time honestly thought that the day would never come when the cable would be displaced from the streets of heaviest traffic in larger cities. Later Mr. Bailey had his duties as manager of the railway department somewhat enlarged by being made assistant manager of the Western office. In Mr. Bailey the L. E. Myers Company has secured a strong addition to its forces.

MR. PHILIP BALLINGER has been made superintendent of the electrical division of the Consolidated Gas Company of New Jersey.

MR. EDWARD T. KEENAN, of Ponca City, Okla., has opened an office in that city intending to do electrical engineering. The Southwest will receive his special attention.

MR. PERCY R. FROST, formerly purchasing agent for the Carleton-Chase Electric Company, has become president of the Union Electric Company, a new electrical supply concern whose headquarters are in the Park Building, Pittsburg, Pa.

MR. ALFRED J. JUPP, who has for several years been manager of the Eastern department of the Lunkenheimer Company, has just returned from a trip to Europe, where he was looking over the field of export. He has recently assumed charge of the export department of the company in addition to his former duties.

MR. HARRY JONES, electrician, has been made manager of the Wrightsville, Pa., electric light plant. In the near future the company will be consolidated with the water company. The stockholders of the latter have absorbed control of the former. The articles of joint incorporation have not yet been applied for, but will be in the near future.

MR. J. H. JACOBY, who has for the past six years been superintendent of telegraph of the Lehigh Valley Railroad Company, will retire on Jan. 1, 1905, that office having been abolished by the new management. Mr. Jacoby has been in the railroad company's employ 25 years, and during his incumbency as telegraph superintendent made many improvements in the railroad's telegraph and telephone systems.

MR. HARRY D. REED, son of Mr. H. A. Reed, and superintendent of the Bishop Gutta Percha Company, of New York City, was married on December 15 to Miss Emilie Currier, daughter of Mr. and Mrs. Osceola Currier, of Newark, N. J. Their wedding trip will include Washington and Virginia Hot Springs. A host of friends in the electrical field are extending to the happy pair their heartiest congratulations and good wishes.

MR. THOMAS D'ORNELLAS has signed a contract with the Peruvian Government to act as electrical engineer and adviser to the Government. Mr. T. V. d'Ornellas, who had been for some time previously connected with the Union Elektricitats, in Berlin, has been these recent years in charge of the technical department of the Compania Iberica Thomson-Houston, in Madrid. Mr. d'Ornellas' new headquarters will be in Lima, Peru.

MR. GEORGE S. RICE, deputy chief engineer of the New York Rapid Transit Commission, has been appointed chief engineer to succeed Mr. W. B. Parsons, who resigned recently on account of his connection with the Panama Canal Commission. The salary is $10,000 a year. Mr. Parsons has been retained as consulting engineer at $10,000, but will not receive compensation for periods when he is out of the country on Panama Canal or similar professional work.

MR. S. M. KEEBLE, who has for many years been associated with the Frank Adam Electric Company, of St. Louis, and under whose management its switchboard business has developed into one of the most important of its kind in the West, has resigned his position and has assumed the position of general sales manager of the Cutter Company, with headquarters in Philadelphia. Mr. Keeble's familiarity with the circuit breaker and instrument business, the result of his long experience, should make his services of great value in his new position.

MR. ERNEST GONZENBACH has resigned his position as engineer of the Youngstown & Southern Railway Company to accept that of general manager of the Sheboygan Light, Power & Railway Company, of Sheboygan, Wis. This company operates 31 miles of city and interurban railway, a lighting plant and an amusement park. Mr. Gonzenbach will assume the duties of the his new office on January 1, 1905. No successor to Mr. Gonzenbach has been appointed on the Youngstown & Southern Railway Company, and construction work will be discontinued until spring.

PROF. E. M. BLAKE, University of Arizona, Tucson, Ariz., writes under date of December 16 as follows: "The Department of Mechanics of the University of Arizona has started an indexed catalogue file covering steam and gas engines, electro-dynamic, hydraulic, mining and milling machinery, fittings and supplies, and also a collection of mechanical devices, machine parts, fittings and samples of supplies and materials of machine construction. The file and collection are to be used for purposes of instruction in mechanical and electrical subjects. Any contribution to either will be very welcome."

MR. GEORGE WESTINGHOUSE.—Here is an incident, illustrating how business problems pursue the inventor of the air-brake, writes Theodore Nevin, in the January *World's Work*. A few years ago a game of whist was progressing smoothly, when after one of the deals Mr. Westinghouse did not pick his cards up, but kept drawing on a piece of paper before him. The others watched him curiously, remarked that they were ready to proceed, and then waited and waited, unable to understand why he should pay no attention to them. Suddenly, with a flash of triumph in his eye and exultation in his voice he cried out, "Brown, I've got that natural-gas meter fixed—here it is; it cannot fail to work successfully," and picking up his cards he asked, "Whose turn is it to play?"

MR. CAMPBELL SCOTT.—We are advised that Mr. Campbell Scott has resigned his position of secretary and general manager of the C. & C. Electric Company, New York, to take effect on January 1, 1905. Mr. Scott has been prominently identified with the company for some seven years, acting formerly as general sales manager, and for the last five years as secretary and general manager, during which time the company has taken a very prominent position in the electrical machinery field, largely due to his efforts. We understand that Mr. Scott has been contemplating this action for some time past, but has deferred it until he had seen the completion and successful launching of their new line of Type "S" dynamos and motors, which are now meeting with decided favor. Mr. Scott has not yet announced his plans for the future, but it is rumored that he is going into business on his own account.

MR. J. U. JONES, of Dallas, Tex., one of the best known salesmen in the Southwest, has joined the staff of the Allis-Chalmers Company, of Milwaukee, and will hereafter represent the Company and its widely varied products in Texas and its tributary territory. He began his business life as a machinist in the locomotive department of the Texas & Pacific Railroad. Then for nine years he was superintendent of the plant of the Paris Gas & Electric Light Company. Leaving that position he built the Crook-Record Plant in Paris, Tex., and operated it as manager for two years. A combination of the two plants was effected through the efforts of Mr. Jones, who managed the two for a year afterward, as superintendent. The next event in his business career was his joining the Southwestern Electrical & Construction Company, of Dallas, Texas, as traveling salesman and superintendent of erection for the plants which the firm installed. Leaving that firm he was for three years in a similar capacity with Collins & Delaney, of Paris, Tex., and later with the Murray Company, remaining with the latter concern until the time of making his present arrangements with the Allis-Chalmers Company.

MR. ALONZO BURT.—President Alonzo Burt, of the Wisconsin Telephone Company, has resigned as president of the Missouri and Kansas Telephone Company which controls the Bell interests in Missouri, Kansas and Oklahoma, and official announcement is made that Mr. Burt will arrive in Milwaukee on Jan. 1 to take charge of the Wisconsin Company. Mr. Burt has made several visits to Milwaukee during the last year, and is acquainted with the details of the Wisconsin concern. His office will be in the new building which the company will erect on Fifth Street and Grand Avenue. Mr. Burt went to Kansas City about ten years ago to represent the Bell interests in the Missouri & Kansas Company. He became general manager and afterward president of the company. A few years ago the Wisconsin Telephone Company elected him president. It has headquarters at Milwaukee. Running both companies proved a heavy task, and Mr. Burt finally objected. He was offered two or three other positions, but finally decided to go to Milwaukee to live, and manage the Wisconsin Company. He asked to be released by the Missouri & Kansas Company, but was given a vacation, and took a trip to Europe instead. When he came back he decided to quit the Missouri & Kansas Company, and a successor will be elected on Jan. 15.

NEW MEMBERS OF THE INSTITUTE.—The following 27 gentlemen have been elected associate members of the American Institute of Electrical Engineers: Allen, Charles V., sales and electrical engineer, Westinghouse Electric & Mfg. Co., 11 Pine St., New York City; Browne, Robert Jamieson, electrical engineer, Bengal Command, Military Works Services, Govt. of India, care Grindlay & Co., Hastings St., Calcutta, India; Cowgill, John Shepherd, electrical engineer, Fairbanks Morse Co., Three Rivers Electric Works, Three Rivers, Mich.; Ensign, Orville Hiram, mechanical and electrical engineer, Edison Electric Co., Los Angeles, Cal.; Forsythe, William Craig, superintendent, Electric Light Plant, Tallahassee, Fla.; Foster, Francis Perry, superintendent, Fire Alarm Telegraph, Corning Fire Department, City Hall, Corning, N. Y.; Hamner, Charles Sutherland, Foreign Engineering Dept., General Electric Co., Schenectady, N. Y.; Henderson, John Steele, 414 Franklin Ave., Wilkinsburg, Pa.; Heywood, James, assistant superintendent Lines and Cables, Philadelphia Rapid Transit Co., Philadelphia, Pa.; Kent, James, salesman, Fort Wayne Electric Works, 518 Exchange Building, Boston, Mass.; Kroger, Fred Hutton, assistant in electrical engineering, University of Colorado, Boulder, Colo.; McCullough, Homer, electrician, Bismark Nugget Gulch Mining Co., Sheridan, Mont.; Monjo, Domingo L., electrical contractor, 11 Broadway, New York; Pahl, August Julius, California Gas & Electric Corporation, Rialto Building, San Francisco, Cal.; Peck, Henry Waterman, electrical engineer, Westinghouse Electric & Mfg. Co., Wilkinsburg, Pa.; Pope, William Godfrey Thomas, R. Almeida e Souza 23 Lisbon, Portugal; Pressey, Henry Albert, civil engineer, 408 Colorado Building, Washington, D. C.; Rowe, Norman, general superintendent, Guanajuato Power & Electric Co., Guanajuato, Mexico; See, Pierre, V. C., car inspector, Metropolitan West Side Elevated Railway, Chicago, Ill.; Shane, Adolph, acting assistant professor, Iowa State College, State College, Ames, Iowa; Specht, Hans Christian, electrical engineer, Westinghouse Electric & Mfg. Co., East Pittsburg, Pa.; Spiegel, Alexander S., Chicago Telephone Co., Chicago, Ill.; Stitt, Frederick Starr, solicitor of patents, 15 William St., New York City; Talbott, William Maurice, superintendent, Red Telephonica, 20 Zuluetra St., Havana, Cuba; Williams, John Rutledge, sales manager, Birmingham Equipment Co., Birmingham, Ala.; Woltz, Roscoe, student, General Electric Co., Lynn, Mass.; Wood, Walter, managing partner R. D. Wood & Co., Philadelphia, Pa.

Trade Notes.

THE WALLACE BARNES CO., Bristol, Conn., is sending out to the trade a neat booklet describing the various springs it manufactures, as well as other lines in wire and cold rolled steel.

THE LIMA INSULATOR COMPANY, of Lima, N. Y., manufacturer of high grade porcelain insulators has given the agency of its business in Chicago to the W. R. Garton Co., of that city.

THE HENRY S. SPACKMAN ENGINEERING COMPANY, of Philadelphia, announces the removal of its offices and laboratories from 1619 Filbert Street to 42 North Sixteenth Street, that city.

THE BANNER ELECTRIC & MANUFACTURING COMPANY, which was recently incorporated at Oklahoma City, Okla., note of which was made in our issue of December 10, will carry a general line of electrical supplies, automobiles, automobile supplies, etc., and wishes to act as manufacturers' agent in either line. Mr. C. B. Luck is one of the officials of the company.

THOMPSON-RYAN DYNAMOS are very completely described and excellently illustrated in Bulletin No. 14 recently issued by the Ridgway Dynamo & Engine Company, Ridgway, Pa. The illustrations show the details of construction very clearly, the characteristic features of design of this machine being prominently brought out. Other illustrations show belted generators, and a motor-driven booster set.

UNION ELEC. MFG. COMPANY.—The Union Electric Mfg. Company, of South Bend, Ind., 221 City Hall Court, is conducting an electrical repair and armature rewinding business. The company has excellent facilities for this. Later on it intends to manufacture small electrical specialties. but has

made no special effort in that direction as yet. The president and manager is Mr. James Holstrom, who was in the Chicago engineering department of the General Electric Company for nine years. Mr. D. MacGregor is secretary and treasurer.

PULVERIZING MACHINERY is the subject of a special catalogue issued by the Jeffrey Manufacturing Company, Columbus, Ohio. This apparatus is designed to pulverize asbestos, coke, copper ore, carbon, Portland cement—in fact anything that is capable of being so reduced. Illustrations show the construction of the machines. The Jeffrey Company has recently added this line of work to its already extensive business, having purchased the patents from the Schoellhorn-Albrecht Machine Company, covering its crushing machinery. A complete price list forms a part of the catalogue, which has 52 pages.

A CHEAP BOOK.—The book department of the ELECTRICAL WORLD AND ENGINEER, in cleaning house for its New Year inventory, has discovered a package of old stock which it inherited, but had not previously investigated, owing to wrong designation. The package turns out to contain 150 copies of Urquhart's excellent book on electric lighting, published in 1890—400 pages, 150 cuts, and issued originally at $3. The book remains a valuable and useful work, and as announced elsewhere, the department is offering it for "a song," in order to dispose of the remnant. Many of our readers will be glad to secure a copy of this admirable treatise and permanent historical record.

THE BERGMANN ELECTRICAL WORKS, Berlin N, Germany, Department "J" (Installation Material), 33-35 Hennigsdorfer St., have just issued a new export catalogue, No. 8E, a 234-page volume, which includes everything that is new and practicable in the shape of conduit tubes, switchboards, switches, cut-outs, lampholders, etc. Every article is described in detail; prices, measurements and shipping weights are quoted. There is also a preface in which terms of sale, freighting, etc., are discussed. In fact, the catalogue is a model of its kind. The same is sent free to inquirers. Our readers should write also for their other price lists which are printed in the English, German, French and Spanish languages.

MAP OF NEW YORK CITY.—The passenger department of the New York Central & Hudson River Railroad has just issued a very interesting and useful map of New York City, embracing the bay, Hudson, East and Harlem Rivers. It shows an area of four miles from Grand Central station in every direction. The names and location of 77 hotels are given; also, the names and location of 78 clubs and 49 theatres. The piers of the various lines of steamships are distinctly marked, as well as the numerous large and small parks located in various parts of Greater New York. The map is most valuable to strangers visiting the "Wonder City" and can be obtained by sending a two-cent stamp to George H. Daniels, General Passenger Agent, Grand Central Station, New York City.

AUXILIARY ENGINES.—The rigid specifications drawn by the United States Navy Department for auxiliary engines required in the equipment of vessels of recent construction, have done much to improve their general standard of efficiency. It is therefore unusual to find that even these exceptional requirements have been improved upon. Such, however, is noticeably true in the case of recent designs of vertical cross-compound engines built by the B. F. Sturtevant Co., Hyde Park, Mass., for direct-connected generator driving. They have actually shown upon an economy test a consumption of steam per horse power per hour fully four pounds less than that demanded by the specifications. These results are characteristic of a line of specially high grade engines being built by the above-mentioned company to develop from 25 to 150 horse power.

WILLIAMS ELECTRIC MACHINE COMPANY.—A new entry into the electrical manufacturing field is the Williams Electric Machine Company of Akron, Ohio. Financed by some of the best and strongest financial interests of that city, this company is placing on the market a full line of electric clutches and electric stopping or safety devices to be used in stopping the machinery in case of accident to the operator. These clutches, etc., are the invention of Mr. H. A. Williams, who is the general manager of the company. This concern is also placing on the market a full line of electrical apparatus both alternating and direct-current generators, motors, switchboards, controllers, etc., and undertake the installation of complete transmission plants embracing clutches, safety devices, generators, engine motors, switchboards, line shafting and hangers, pulleys, etc., making a specialty of equipping plants complete all ready for operation.

A GREAT SCRAP HEAP.—The Chicago House Wrecking Company, West Thirty-fifth and Iron streets, has recently bought the entire St. Louis World's Fair plant buildings, etc., including a vast quantity of electrical material, all of which is now available for use again. In regard to the general subject they say: "In building the World's Fair of St. Louis, $50,000,000 was expended. The markets of the world were searched in securing necessary material to construct this unrivalled exposition. It required years of endless toil to complete it. At the close we bought from the Louisiana Purchase Exposition the complete exposition. This purchase means that we are sole owners of the greatest show on earth. Our purchase is a most complete one, including even the plants and shrubs. Over a thousand men will be employed by us in this undertaking. It will require fully 10,000 carloads to move the material. Almost every manufactured article is for sale in this proposition." This is probabily the largest "deal" of the kind ever made.

THE KUSEL & KUSEL COMPANY, No. 617 Monadnock Bldg., Chicago, is placing on the market in its "Ring-Thru" telephones, what it terms its K. & K. magnetic "ring-thru" coil. This is a special device, to obviate the use of condensers, choke coils, carbon resistance coils and non-inductive wound coils, for the purpose of enabling the subscribers line, and bridged or party line to "Ring-Thru" with the receivers off the hooks. The Kusel & Kusel Company claims superior features with this coil, without any additional complication of apparatus in the circuit, and greater talking power in the microphone circuit as well. The company is furnishing these improvements in its telephones regularly or will furnish them separately to companies that wish to install them in their present telephones. The company's new 1905 loose-leaf bulletin catalogue will issue from press within a few days. It will be pleased to send a copy to any operating concern interested. This catalogue describes its full line of apparatus, containing many new features.

THE H. W. JOHNS-MANVILLE CO. has just issued a new catalogue of Sachs "Noark" fuses and fuse devices, for all voltages. The fuses and fittings are classified for the various voltages and types in such a manner as to greatly facilitate the selection of a device to fill the existing requirements. All commercial and technical data pertaining to the articles listed can be obtaned with very slight effort. For instance, "Noark" standard fuses and fuse devices are classified first in the following voltages: Devices to be used up to and including 250 volts are known as "250 volt devices," and all matter pertaining to them is printed in a section of the catalogue on green tinted paper; the fuse devices used in voltages up to 500 or 600 volts, are listed in another section on yellow tinted paper; the fuse devices used on 1500, 2500, 5000 and 10,000 volt service are listed in the remaining section and are printed on pink paper. Each particular form of fuse or fuse device is shown on a separate chart, on which the catalogue number, code word, standard package, carton quantities, and list prices are given, as well as general information for their use. The chart also shows in red print all the dimensional information descriptive of the charted devices. "National Electric Code Standard" fuses and fuse devices are listed in their proper place according to voltage, type, contact, etc.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 20, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

777,061. CIGAR LIGHTER; James I. Ayer, Cambridge, Mass. App. filed June 15, 1903. An arc is formed between two pencil carbons which can be manually moved into operative position.

777,669. PROCESS OF PRODUCING SALTS OF HYDROSULFUROUS ACID; Albert Frank, Charlottenburg, Germany. App. filed March 8, 1900.

777,677. AUTOMATIC GAS DANGER SIGNAL; Preston A. Kettering, Cadiz, Ohio. App. filed Feb. 16, 1904. When the flow of gas from a burner stops, a weight in the gas passage falls and closes an electric alarm circuit.

777,691. TROLLEY HEAD; Edwin V. Newcomb, Kansas City, Mo. App. filed Dec. 15, 1903. Details.

777,693. ELECTRIC LOCOMOTIVE; Edward D. Priest, Schenectady, N. Y. App. filed May 6, 1904. The cab for a double-ended locomotive has a central apartment and side passages at each end in which the controlling apparatus is located.

777,707. INSULATED JOINT; George A. Weber and Percy Holbrook, New York, N. Y. App. filed Nov. 13, 1903. Details.

777,709. BRUSH HOLDER FOR DYNAMO ELECTRIC MACHINES; Ernst Woehr, Wilkinsburg, Pa. App. filed May 13, 1904. Details.

777,741. BASE FOR ELECTRIC LAMP BULBS; George P. McDonnell, St. Louis, Mo. App. filed March 12, 1904. The base consists of a brass ring slipped over the end of the bulb and having an insulating disk in the end through which a plug extends to enter the stem of the lamp.

777,750. APPARATUS FOR INDICATING THE MAGNETIC CONDITION OF HEATING METALS; George W. Sargent, Reading, Pa. App. filed July 11, 1904. A magnet is arranged to include in its field the heating metal; the response of the metal to the magnetic influence is duly indicated to show when the heating operation should terminate.

777,759. APPARATUS FOR AUTOMATICALLY STARTING ELECTROMOTORS AND FOR REGULATING PURPOSES; Johan Jetmund Thoresen, Bygdo, Norway. App. filed Dec. 2, 1902. One or more chambers in the rotor contains a powdered or granulated resistance material to which conductors are connected, an automatic short-circuit device being in the circuit of the conductors.

777,760. AUTOMATIC SIGNAL SYSTEM; John R. Walsh, Boston, Mass. App. filed Feb. 19, 1904. A number of tappets on the train engage contacts in the track to close certain circuits in a railway station to indicate the destination of the train or the stations at which it will stop.

777,778. SYSTEM FOR CONTROLLING ELECTRIC MOTORS; Henry H. Cutler, Milwaukee, Wis. App. filed July 6, 1903. Each car of a train is equipped with a master controller and motor-generator, and any one controller acts to change the generator field-resistance of a motor-generator, thereby changing the generator voltage. The generator terminals are connected to a train line to which are connected solenoids, by means of which resistance is introduced in or removed from the armature circuit of the train motors. The solenoids have two opposite windings, one connected to the trolley line, and the other to the train-control circuit. By means described, the train-control current may be reversed, and the solenoids controlling armature resistance caused to respond to all the variations in voltage and direction of current of the train control circuit.

777,801. ELECTRIC SWITCH; William J. Murray, Leavenworth, Kan. App. filed May 2, 1904. A switch mechanism attached to the trolley wire and comprising a tappet adapted to be engaged by the trolley wheel.

777,807. TELEPHONE SYSTEM AND APPARATUS; Elias E. Ries, New York, N. Y. App. filed June 23, 1899.

777,808. TELEPHONE TRANSMITTER; Elias E. Ries, New York, N. Y. App. filed June 23, 1900.

777,833. STATIC ELECTRICAL MACHINE; Charles F. Birtman, Chicago, Ill. App. filed Feb. 6, 1904. A special construction of pole changing mechanism capable of use for readily and conveniently changing the polarity of the terminals of the machine.

777,839. MOTOR STARTER; Eugene R. Carichoff, East Orange, N. J. App. filed May 12, 1904. A plurality of separately actuated contacts controlling the sections of the starting resistance, the actuating coils being succes-

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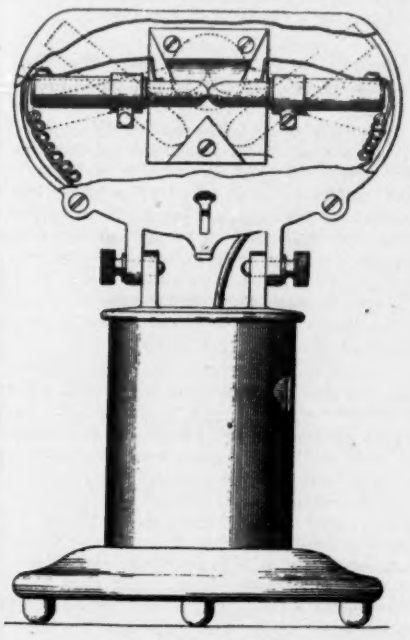
sively connected in the control circuit, each by the operation of the contact next in advance to produce an automatic progression of the contacts.

777,844. METER; Frank P. Cox and William H. Pratt, Lynn, Mass. App. filed Jan. 29, 1903. A meter for measuring the current flow in several circuits, some of which may be direct and others alternating current; the current of all circuits acts upon the same measuring element.

777,851. ELECTRIC BATTERY; William H. Gregory, Vallejo, Cal. App. filed May 14, 1904. A breakable tube containing an extra supply of liquid is arranged within the cell.



777,061.—Cigar Lighter.

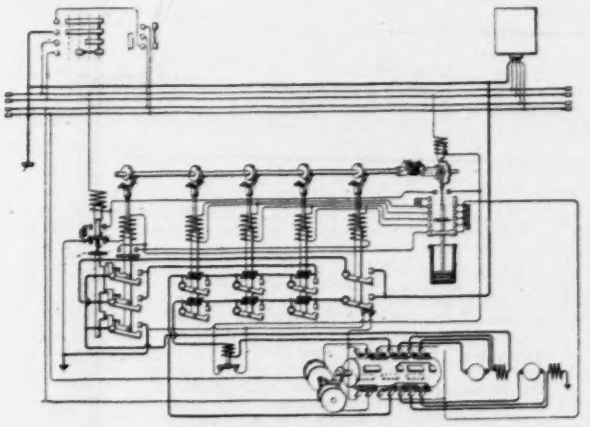
777,857. DYNAMO FOR TRAIN LIGHTING; James F. McElroy, Albany, N. Y. App. filed Sept. 2, 1904. A combined field magnet frame and casing affording a compact device.

777,866. SYSTEM OF DISTRIBUTION; John B. Taylor, Schenectady, N. Y. App. filed May 21, 1904. Automatic means connecting the several sections of a distribution system to each other as long as the sections are in a healthy condition and for automatically disconnecting a faulty section from the others.

777,883. CONTROL SYSTEM; Eugene R. Carichoff, East Orange, N. J. App. filed June 2, 1904. An automatic switch controlling the operating mechanism of the circuit closers and means whereby the closing of each circuit closer places a strain upon the automatic controlling switch, tending to move it slowly to the proper position for energizing the actuating mechanism of a second circuit closer.

777,912. TROLLEY CROSSING; Edward R. North, Webster Groves, Mo. App. filed May 6, 1904. The trolley wheel in approaching a crossing touches a contact and sends current through a magnet that sets a bridging piece in the proper position to allow the wheel to pass uninterruptedly.

777,954. TELEPHONE CHAIR; George J. Just, Northbranch, Ia. App. filed Aug. 15, 1902.



777,883.—Control System.

777,971. HIGH SPEED TRAIN SYSTEM AND APPARATUS THEREFOR; Thomas H. Patenall, Wilkinsburg, Pa. App. filed April 7, 1902. Details of a system in which staffs of certain size and construction are inserted in a switch-controlling mechanism to determine the circuits to be actuated.

777,972. HIGH SPEED PERMISSIVE TRAIN SYSTEM AND APPARATUS THEREFOR; Thomas H. Patenall, Wilkinsburg, Pa. App. filed Sept. 19, 1902. An improvement upon the preceeding invention.

777,974. ELECTROMOTIVE DEVICE FOR CLOCKS; David Perret, Neuchatel, Switzerland. App. filed May 27, 1904. Details.

777,985. BATTERY; Nelson M. Watson, Detroit, Mich. App. filed June 13, 1904.

777,987. APPARATUS FOR THE TREATMENT OF GASES; Ernest E. Werner, St. Louis, Mo. App. filed June 13, 1904.

777,988. PROCESS OF GENERATING GASES FROM AIR; Ernest E. Werner, St. Louis, Mo. App. filed Aug. 6, 1904.

777,989. APPARATUS FOR THE TREATMENT OF GASES; Ernest E. Werner, St. Louis, Mo. App. filed June 13, 1904. (See page —.)

777,990. APPARATUS FOR THE TREATMENT OF GASES; Ernest E. Werner, St. Louis, Mo. App. filed June 13, 1904.

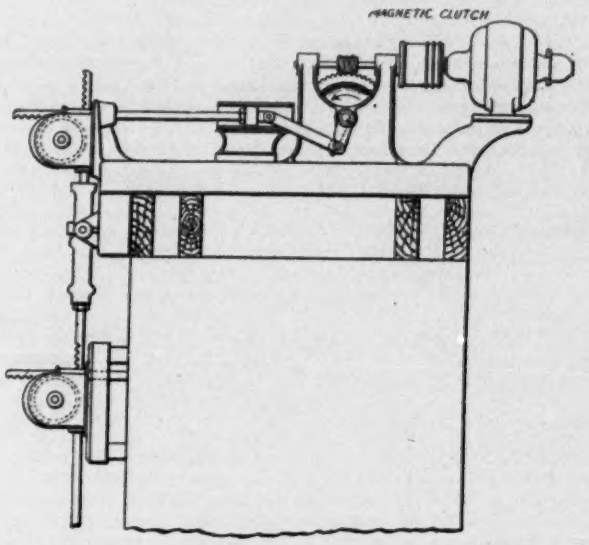
777,991. DEVICE FOR PROJECTING AIR AGAINST ELECTRIC DISCHARGES; Ernest E. Werner, St. Louis, Mo. App. filed Aug. 29, 1904.

778,002. RAILROAD BOND; Horace M. Bellows, Huntingdon Valley, Pa. App. filed Aug. 29, 1904. A coil spring having contact material applied to its ends is inserted in a chamber formed by two borings aligned with each other, in the ends of the rails.

778,005. ELECTRIC INSULATOR; Charles Booker, Toronto, Can. App. filed Feb. 1, 1904. The end of the peg is fitted with a cushion upon which the insulator knob rests.

778,017. TROLLEY GUARD; Mack H. Dorsey, Woodlawn, Ala. App. filed May 24, 1904. Details.

778,021. ELECTROMAGNETIC APPARATUS FOR OPERATING RECIPROCATING MECHANISMS; Joseph Feingold, Frankfort-on-the-Main, Germany. App. filed June 21, 1904. Auxiliary magnets are used in connection with the main magnets which cause the reciprocations of the core, to confine the lines of force in such a manner that the core will get the full benefit of them at each stroke.



778,055.—Electric Switch.

778,037. SIGNALING MECHANISM; Reingold Herman, Crafton, Pa. App. filed Nov. 21, 1903. The signal-moving devices are mounted in a casing on top of the post, which casing is movable bodily with the signal itself.

778,055. ELECTRIC SWITCH; William K. Lloyd and Harold C. White, Pittsfield, Mass. App. filed April 6, 1903. A power operated switch comprising a reciprocating spring-actuated toggle-joint, which affords quick and positive action.

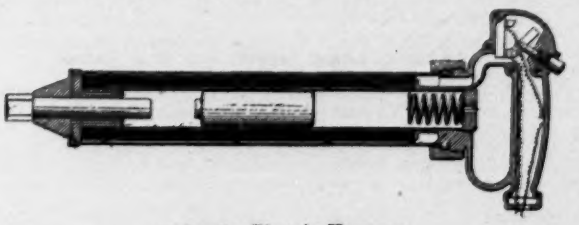
778,067. TELEGRAPHIC KEY; John E. Pearson, Motor, N. C. App. filed Nov. 12, 1903. Details of a key in which the main line circuit is automatically closed whenever the operator removes his hand from the key.

778,073. ELEVATOR HOISTING MECHANISM; Harold Rowntree, Chicago, Ill. App. filed March 4, 1902. In a floor push-button system for elevators is included means whereby the position of the car will be indicated at any floor where a button may be pushed.

778,101. ELECTRICITY METER; Arthur Blanchet, Paris, France. App. filed Oct. 19, 1903. A rotary field meter having a rotating armature, a differential magnet energized by components of the main current and acting upon the armature and having a bodily displacement in order to produce auxiliary torques proportional to the squares of electromotive force and intensity.

778,120. MULTIPLEX TELEGRAPHY; Thomas B. Dixon, New York, N. Y. App. filed May 16, 1904. A double-current transmitting instrument for producing in the line a current impulse at the beginning and again at the end of each signal, both impulses having the same direction, and a single-direction, double-current receiving instrument adapted to be changed from, and restored to, normal condition by alternate current impulses of the direction of the impulses produced by the operation of the transmitter.

778,133. MOTOR VEHICLE; Warren H. Keates, Atlantic City, N. J. App. filed May 27, 1904. The vehicle has two batteries, a generator and a motor; when the vehicle is coasting, it drives one generator to charge one battery, the other battery and motor being used for propelling until it becomes necessary to recharge the battery.



778,206.—Electric Hammer.

778,146. GAS ENGINE IGNITION DYNAMO; John Reek, Camden, Mich. App. filed March 16, 1903. Details.

778,155. INCANDESCENT ELECTRIC LAMP AND SWITCH; George Sweetser, Upper Norwood, England. App. filed Feb. 2, 1904. A filament comprising a light-emitting part which is a non-conductor when cold and a conductor when hot, and a heater part with electrical connections so arranged that any proportion of the heater can be thrown out of circuit at the proper time, leaving the remainder in circuit as a steadying resistance.

778,177. TELEGRAPHY; Thomas B. Dixon, New York, N. Y. App. filed April 22, 1902. A method corresponding to patent No. 778,120.

778,194. ELECTRIC FURNACE; Henry M. Howe, New York, N. Y. App. filed Oct. 3, 1902.

778,206. ELECTRIC HAMMER; William F. Wagner, New York, N. Y. App. filed July 11, 1904. In connection with the reciprocating coil is a demagnetizing coil for releasing the hammer.

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